NATIONAL WEATHER SERVICE

BASIC STORM SPOTTER TRAINING

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NWS Birmingham, AL

Spotter Training Outline

--Disclaimer: This is Not Storm Chaser Training--

Part I

- Who is the National Weather Service (NWS) and why we need spotters
- Severe weather stats and definitions
- What and how to report
- Weather safety

Part II

- Thunderstorm development and types
- Thunderstorm structure
- Tornado development
- Report what you see photo polls
- Spotter information recap

Who is the National Weather Service

- 122 local NWS offices serve different areas of the United States
- A team of meteorologists, electronic and computer technicians
- Work with emergency managers, media, and academia/researchers
- Part of a network of national centers: Climate, Rivers/Hydrology, Severe Storms, Hurricanes, Space weather, National forecasts and analysis, Oceans, Aviation, Modeling

Local NWS Office Forecast Areas

NWS Birmingham

@NWSBirmingham

NWSBirmingham

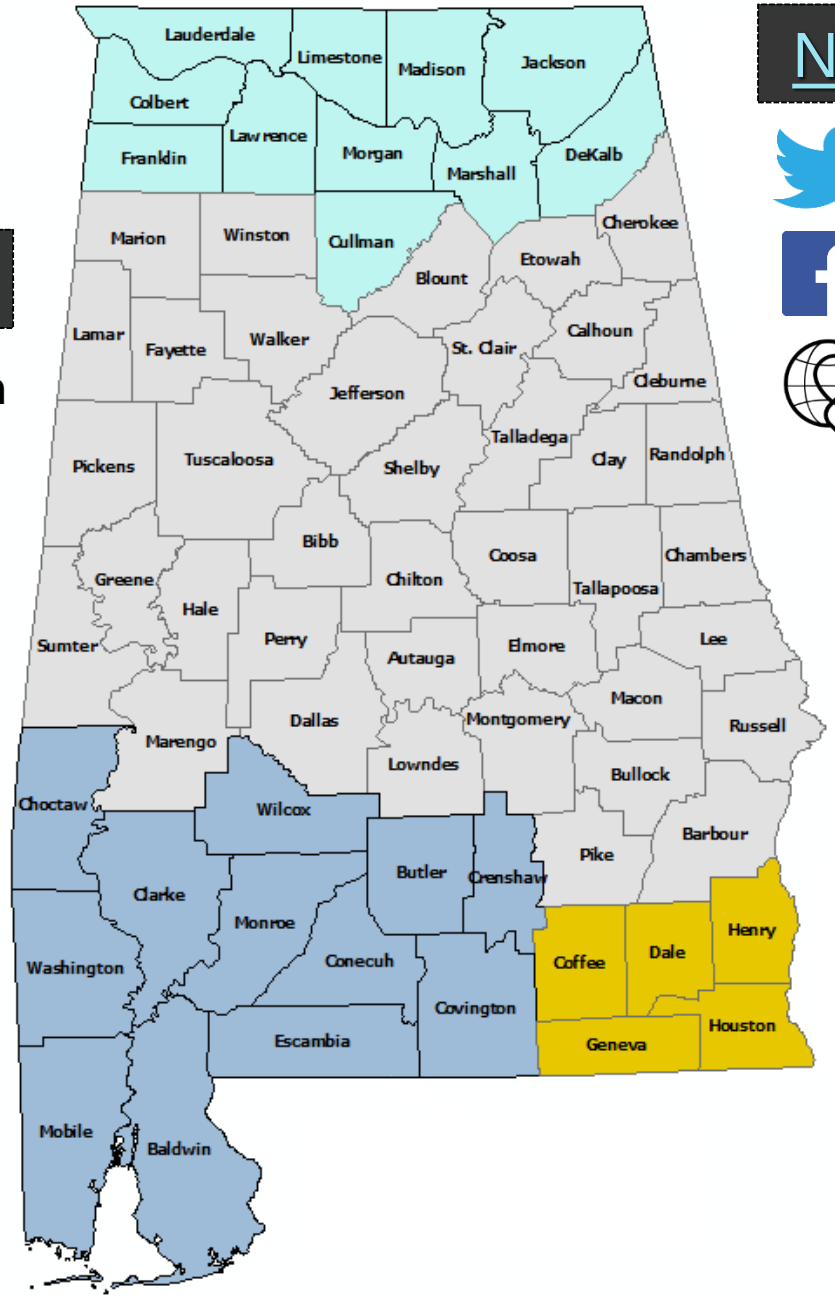
weather.gov/bmx

NWS Huntsville

@NWSHuntsville

NWSHuntsville

weather.gov/hun



NWS Mobile

@NWSMobile

NWSMobile

weather.gov/mob

NWS Tallahassee

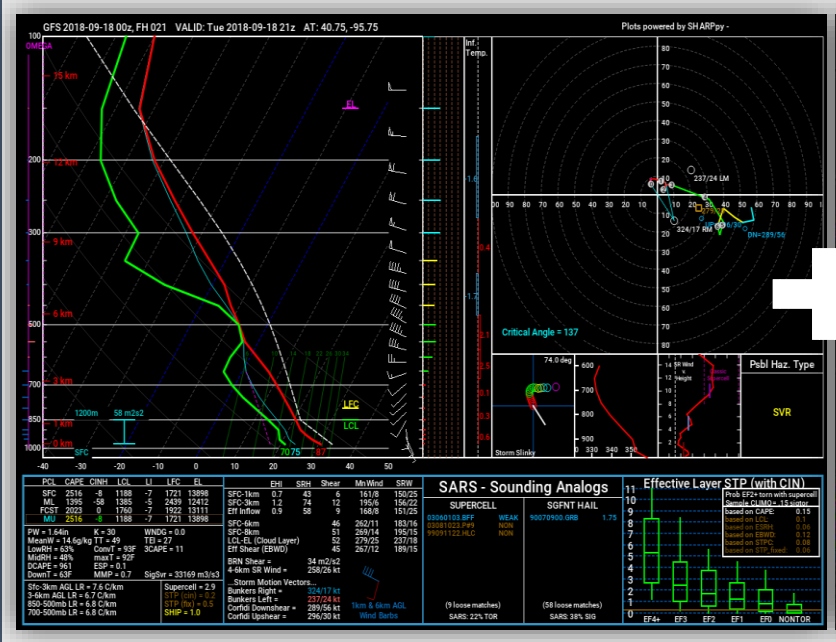
@NWSTallahassee

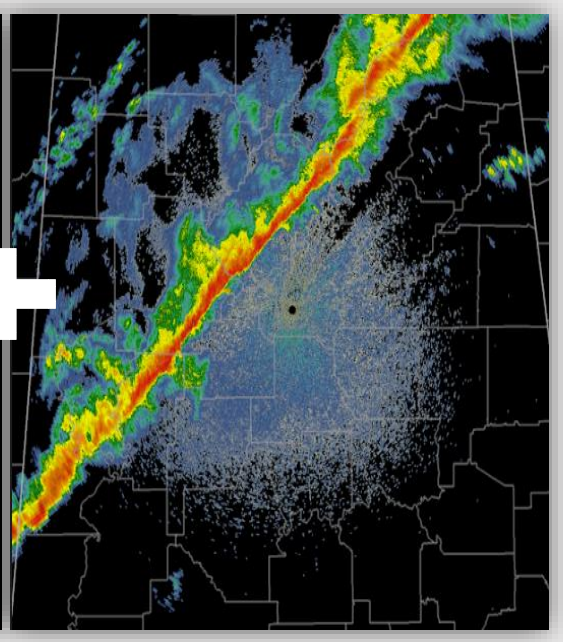
NWSTallahassee

weather.gov/tae

We Operate 24/7/365

How Storm Spotters Can Assist…



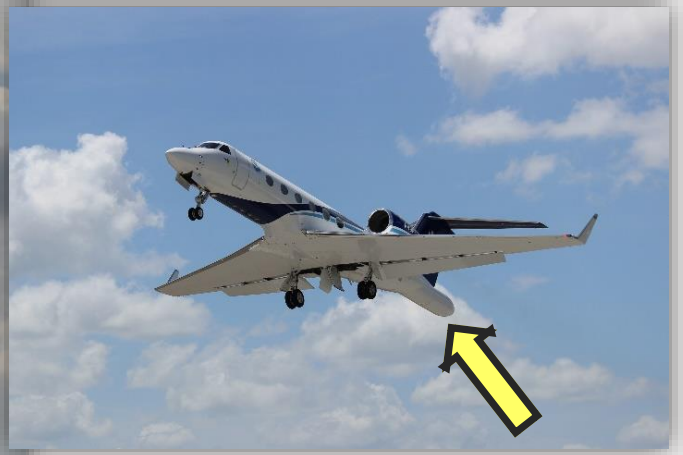


NWS meteorologists combine an analysis of environmental and RADAR data in their warning decision, but this doesn't always **confirm** what is going on or how bad it is.

Storm spotters safely provide reports of what is going on, **confirming** the presence or lack of severe weather. Your information can add credibility to warnings.

Weather RADAR

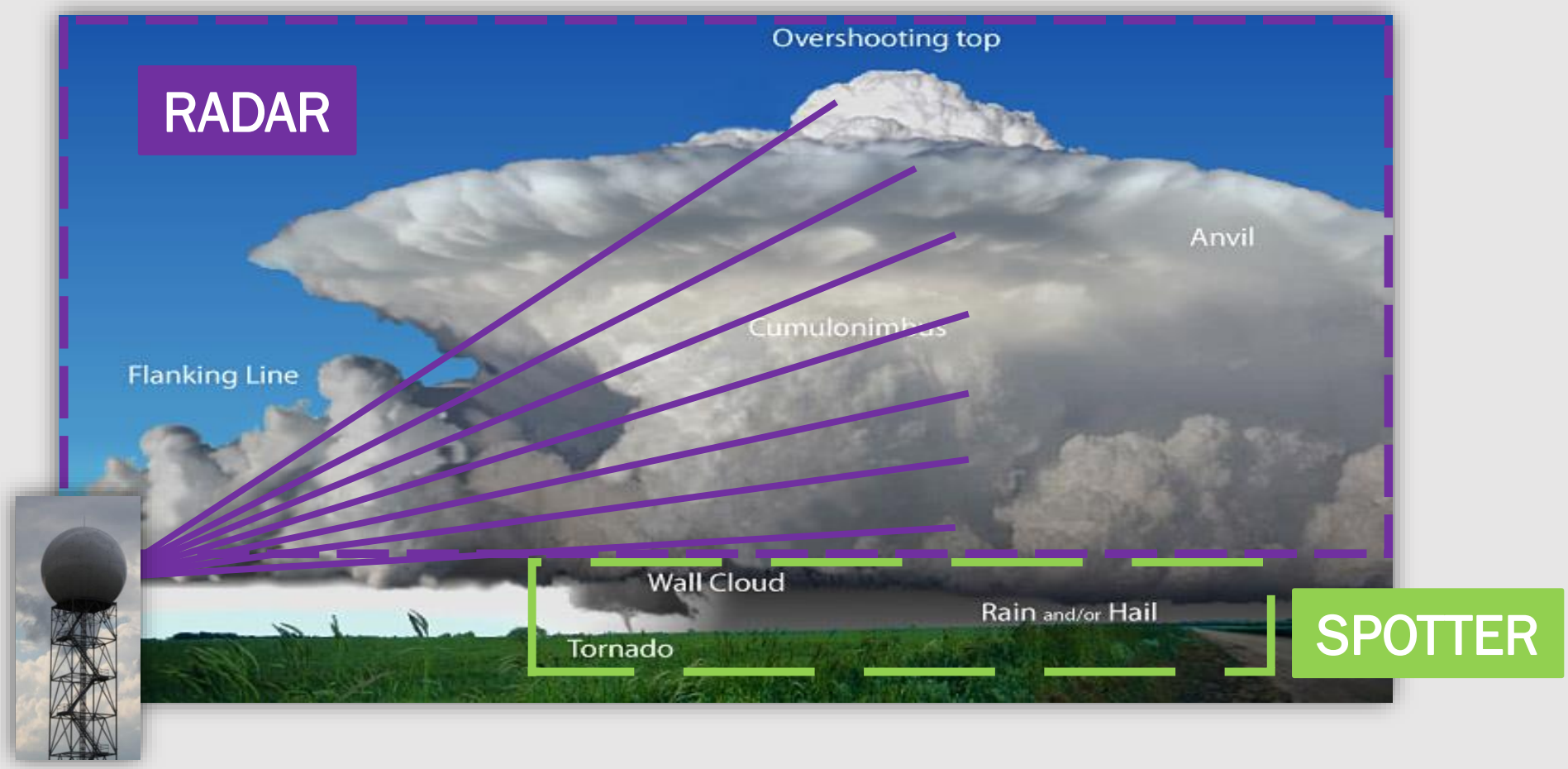
- Precipitation
- Wind speed and direction
  -Green toward radar
  -Red away from radar
- Fronts and boundaries
- Non-weather-related features
  -Tornado debris
  -Smoke plumes
  -Wildlife
  -Wind farms
  - ...and more



Below the RADAR Bean
...Spotters Help Tell the Story

RADAR tells us a storm is capable of producing strong winds, hail, flooding, and/or a tornado -- but can't always *confirm*

Spotters can help *confirm* if a storm is producing strong winds, hail, flooding, and/or a tornado



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What Makes a Storm Severe?

Severe Thunderstorm Warning
potential of __ occurring, or observed

- Wind gusts of 58 MPH or greater, and/or
- Hail 1 inch or more in diameter

-Occasionally, severe thunderstorms can produce a tornado with little or no advanced (tornado) warning

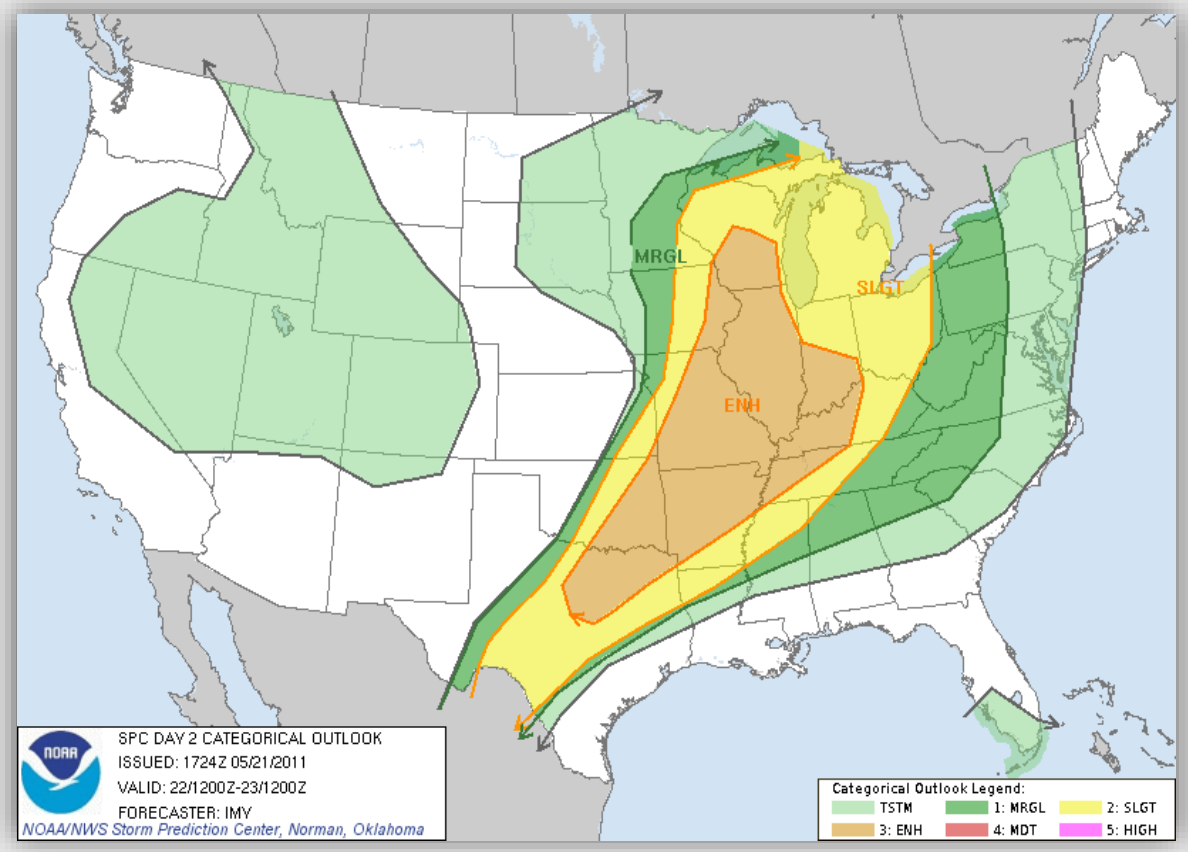
Tornado Warning
Potential of __ occurring, or observed

- A tornado

-Tornadic storms can also produce damaging straight-line wind and/or large hail

Example Severe Weather Outlooks

Storm Prediction Center (National)



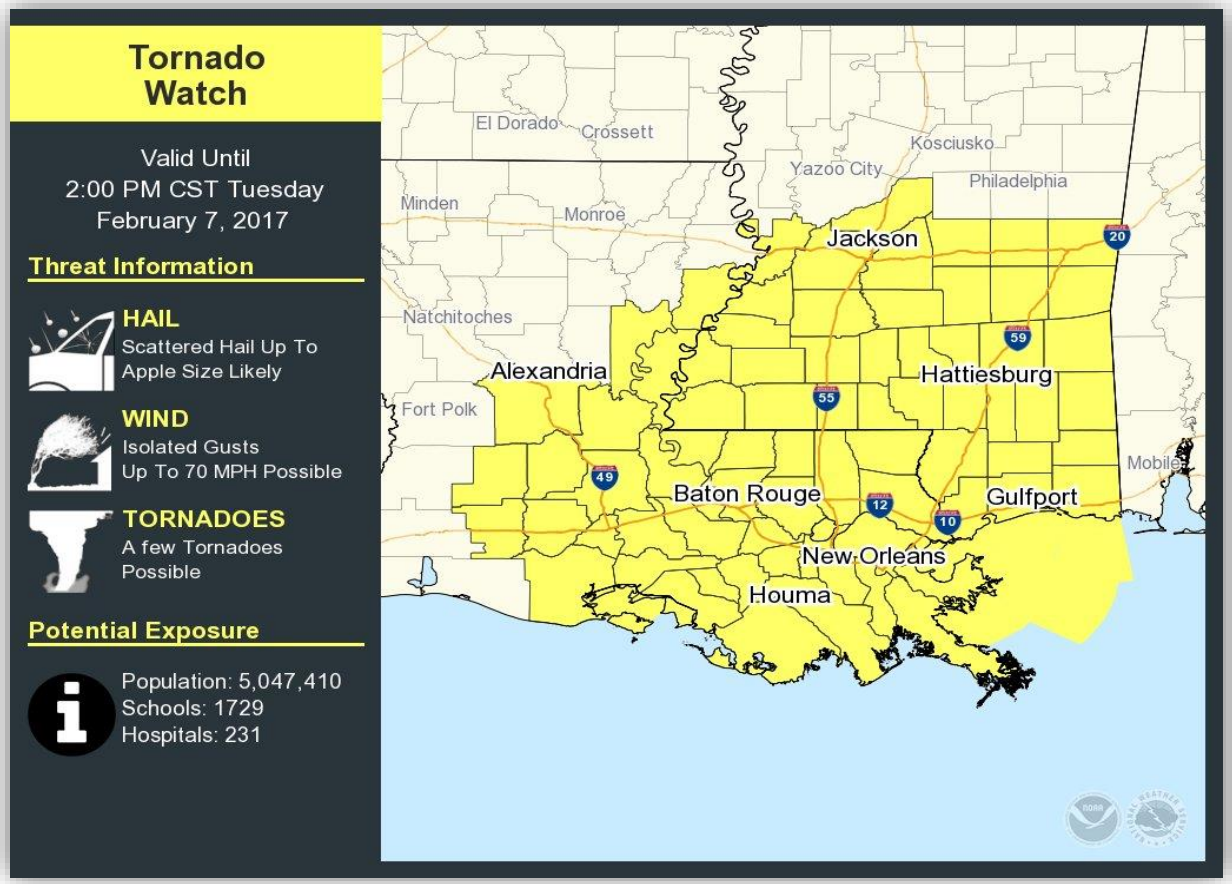
NWS Birmingham (Local)

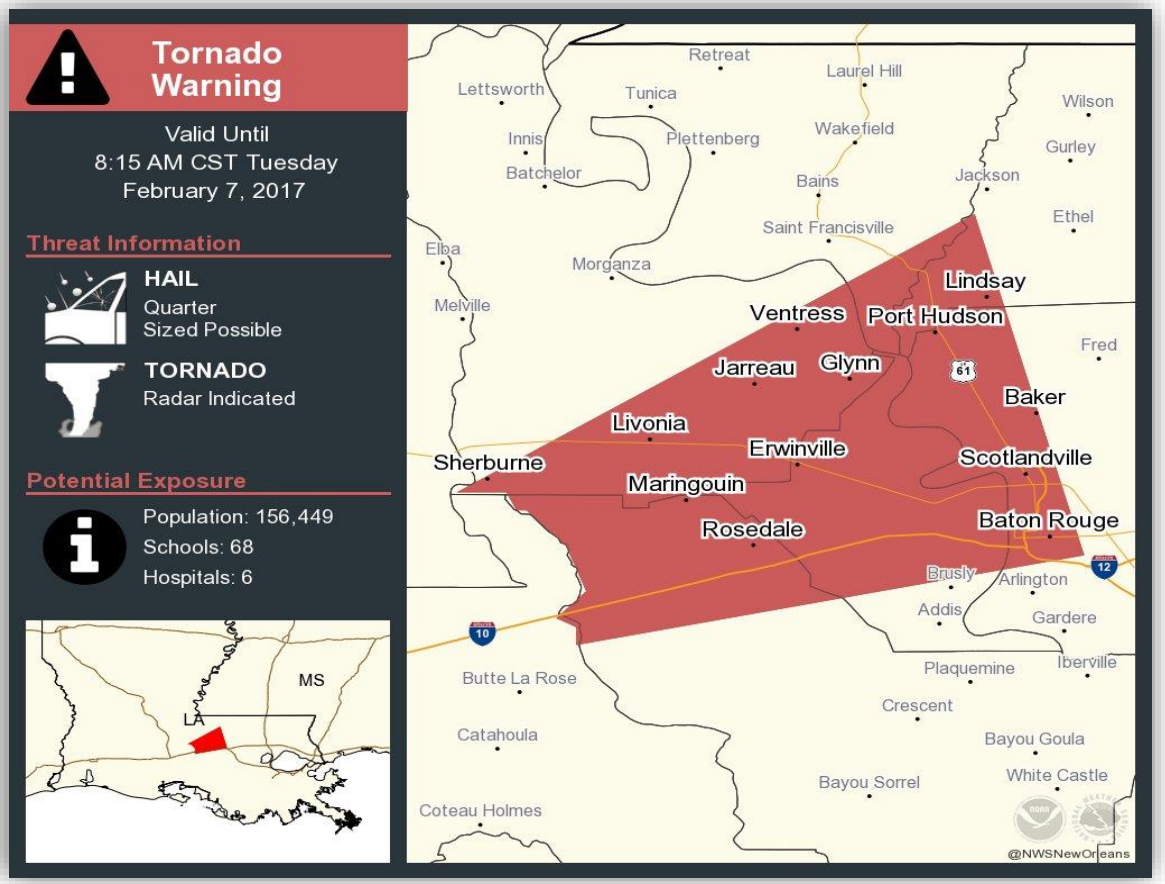
Understanding Outlook Categories

THUNDERSTORMS (no label)	1 - MARGINAL (MRGL)	2 - SLIGHT (SLGT)	3 - ENHANCED (ENH)	4 - MODERATE (MDT)	5 - HIGH (HIGH)
No severe* thunderstorms expected	**Isolated severe thunderstorms possible**	**Scattered severe storms possible**	**Numerous severe storms possible**	**Widespread severe storms likely**	**Widespread severe storms expected**
Lightning/flooding threats exist with all thunderstorms	Limited in duration and/or coverage and/or intensity	Short-lived and/or not widespread, isolated intense storms possible	More persistent and/or widespread, a few intense	Long-lived, widespread and intense	Long-lived, very widespread and particularly intense

* NWS defines a severe thunderstorm as measured wind gusts to at least 58 mph, and/or hail to at least one inch in diameter, and/or a tornado. All thunderstorm categories imply lightning and the potential for flooding. Categories are also tied to the probability of a severe weather event within 25 miles of your location.

Watch vs. Warning

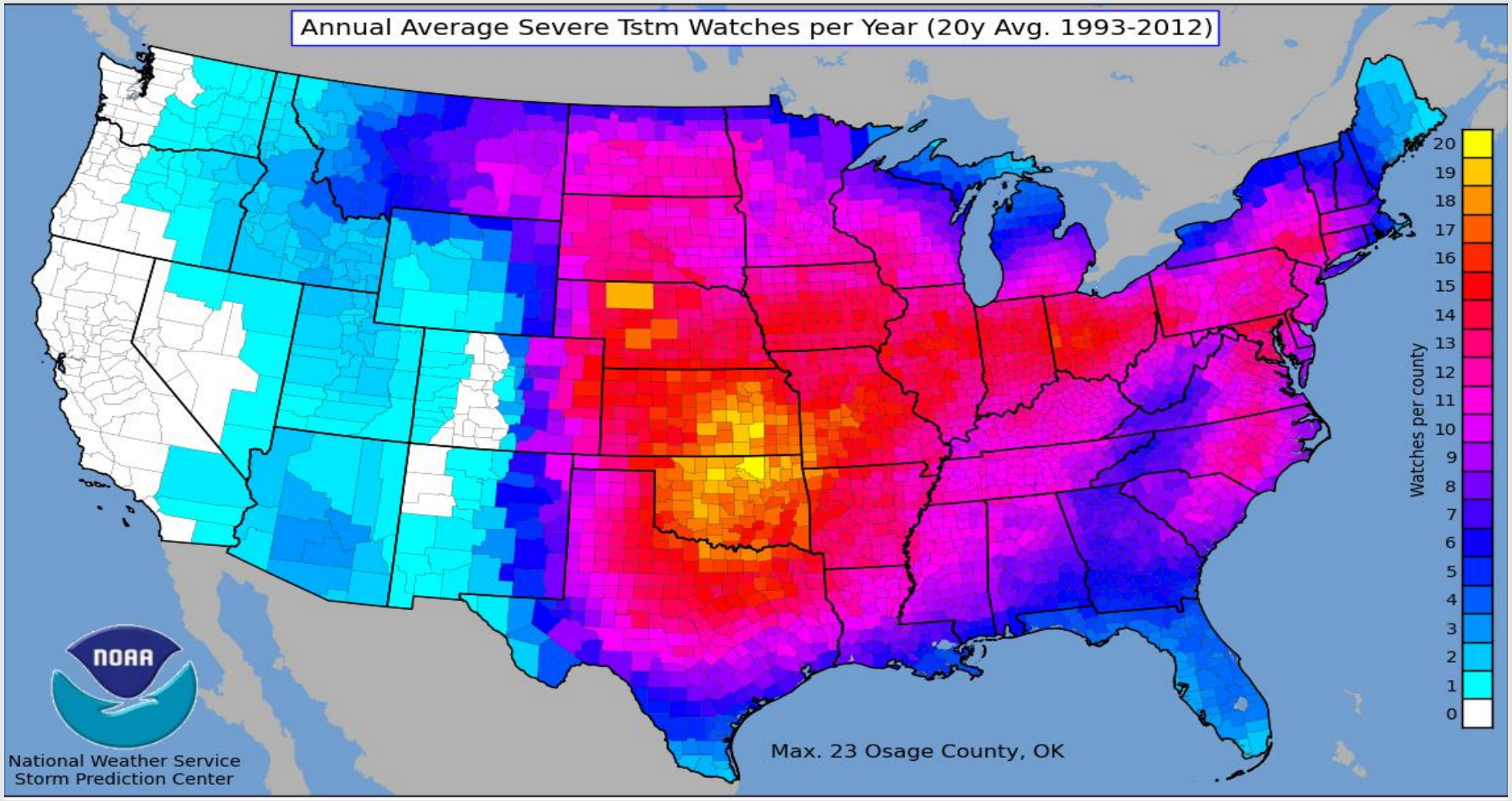




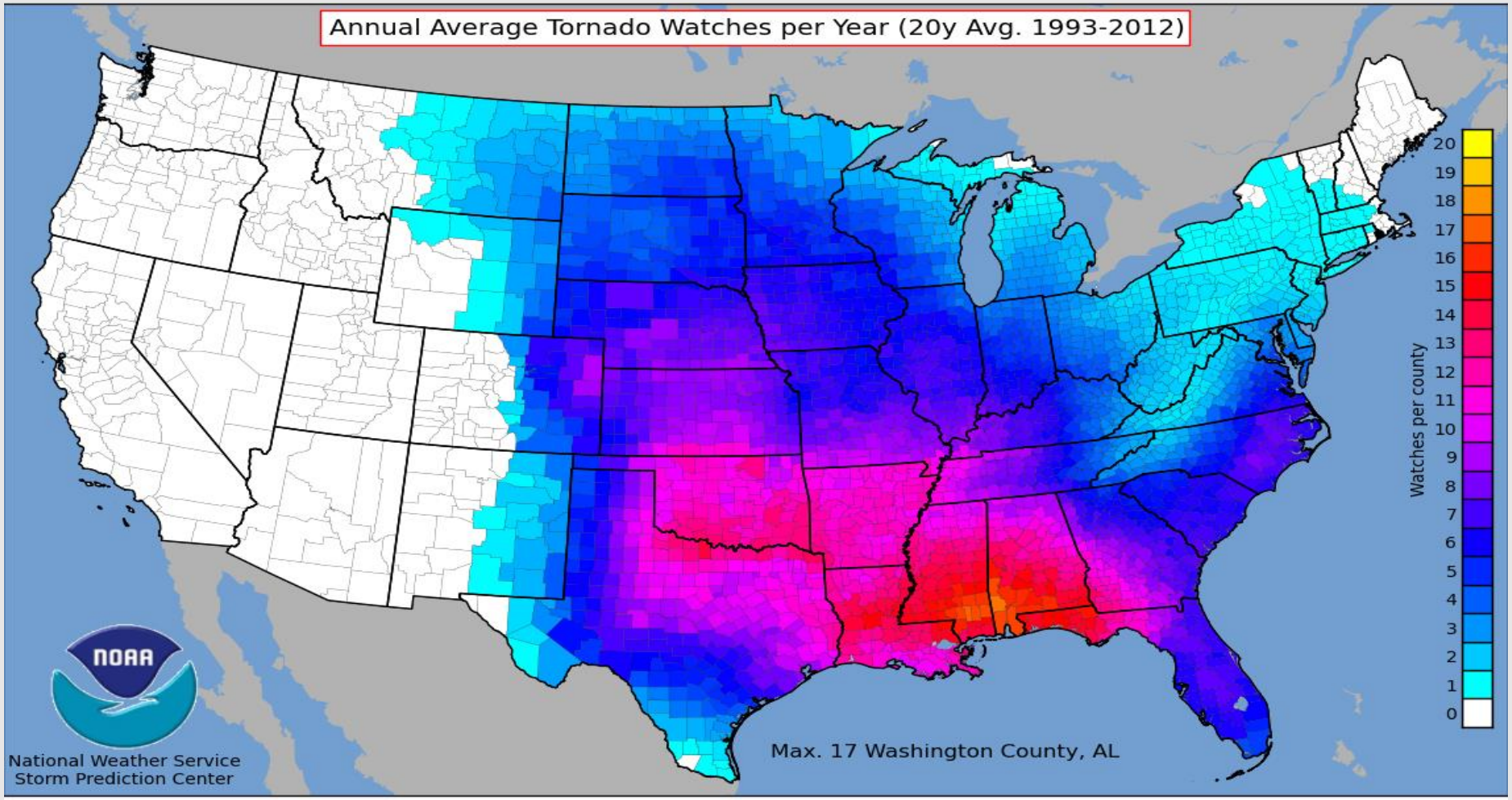
WATCH: Conditions are favorable for severe weather to develop. Watches cover a large area and last several hours. [Be prepared!]

WARNING: Severe weather is likely soon or is occurring. Warnings cover portions of counties and last an hour or less. [Take Action!]

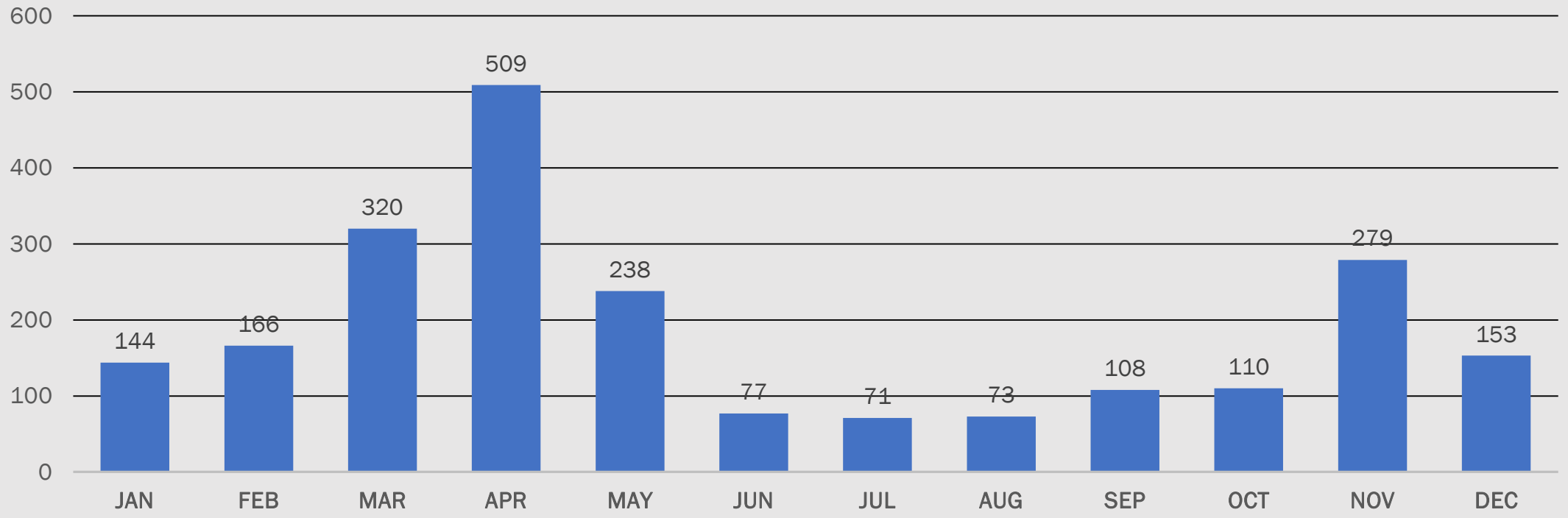
20 Year SPC Watch Climatology --Severe Thunderstorms--



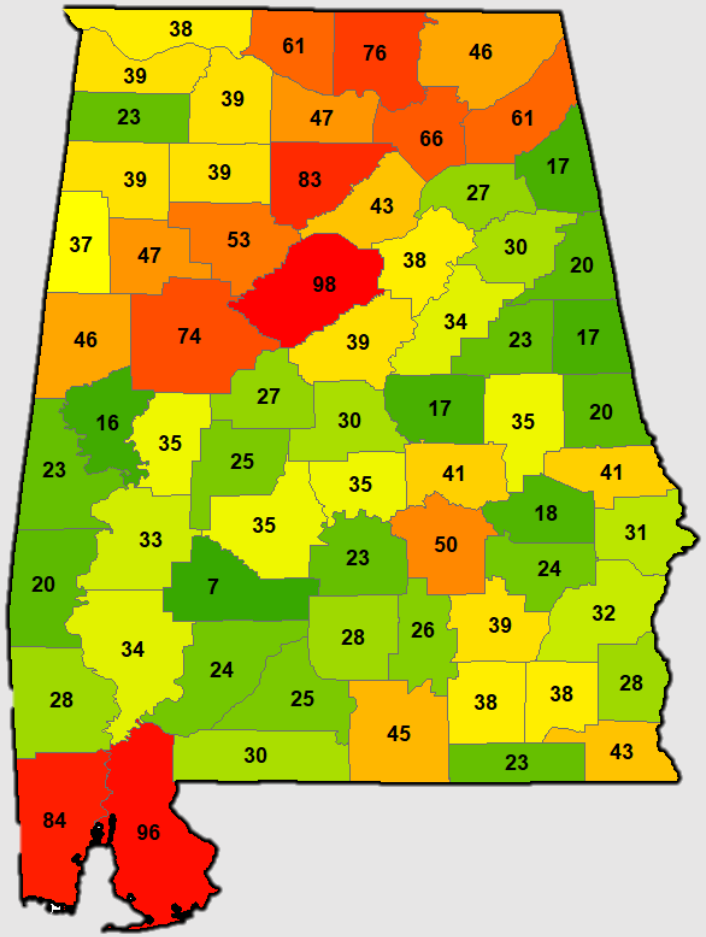
20 Year SPC Watch Climatology --Tornadoes-

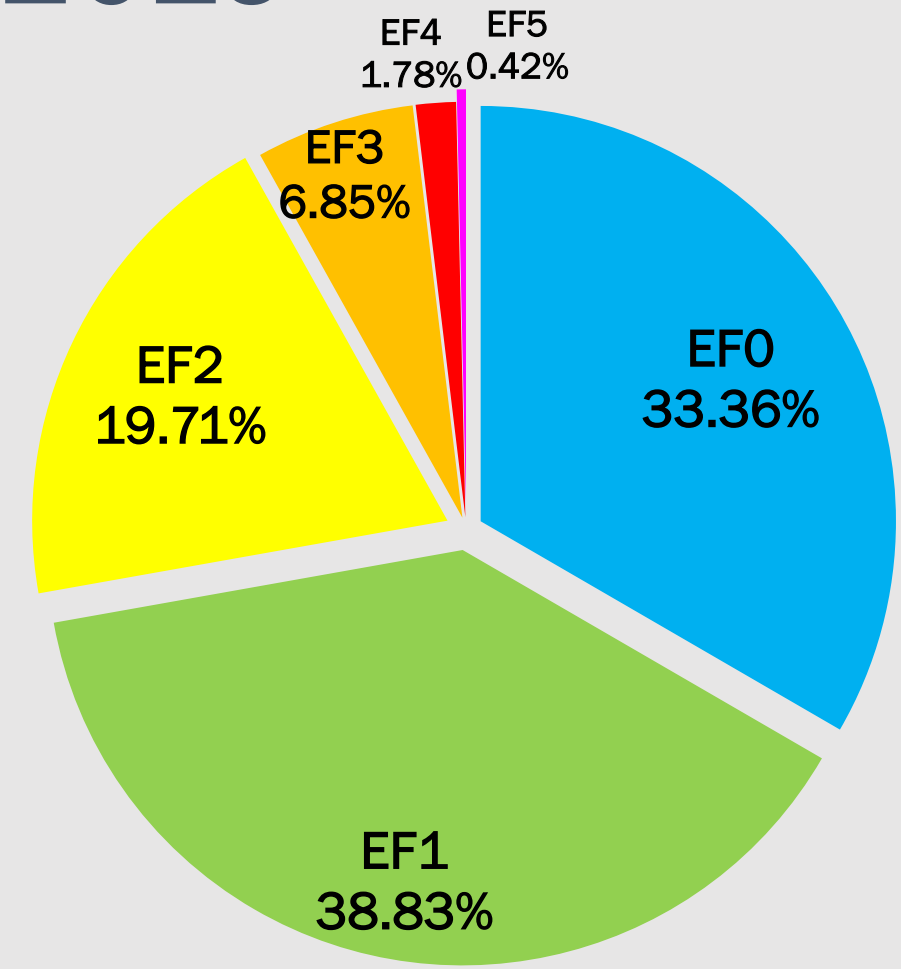


Alabama Tornadoes by Month
Years 1950 to 2019



Alabama Tornadoes by EF Rating (%) Years 1950 to 2019





Rating	Winds
EF0	65-85 mph
EF1	86-110 mph
EF2	111-135 mph
EF3	136-165 mph
EF4	166-200 mph
EF5	> 200 mph

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What to Report
--Strong or Damaging Wind--

*Estimating wind speed is difficult. It is much easier to describe damage.

- Trees or large limbs blown down
  - -Snapped or uprooted?
  - -Are the trees healthy or dead?
- Utility poles downed
- Damage to structures
- High wind
  - -Estimated or measured?

What to Report
--Hail--

- Measure with a ruler or caliper
- Reference a common item

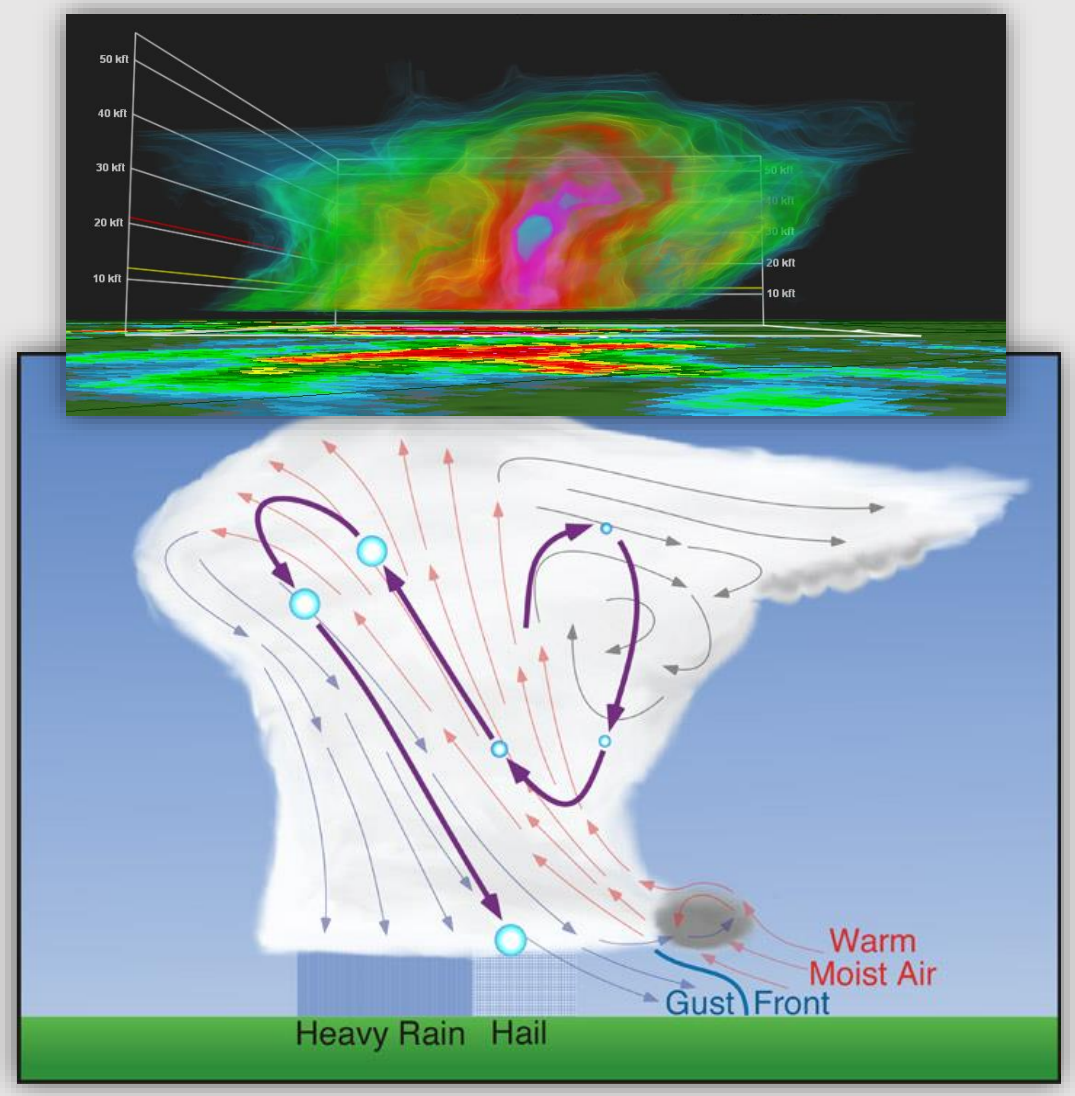
  -Coins (quarter, half-dollar, etc.)

  -Sports balls (golf ball, tennis ball, etc.)
- Did the hail cause damage?

Pause…
It’s Hot Outside … How is there Ice Falling?

Hail Formation

1. Water vapor turned water droplets carried above the freezing level by storm’s updraft *(it is cold upstairs … below zero degrees F)*
2. Some water droplets freeze (hail embryos) while others become supercooled
3. Hail embryos grow into increasingly large hail stones as they collide with supercooled water droplets
4. The stronger the updraft, the longer the hail stone remains lofted and can grow larger
5. Hail stone becomes too heavy to remain lofted and falls to the ground



What to Report --Flooding--

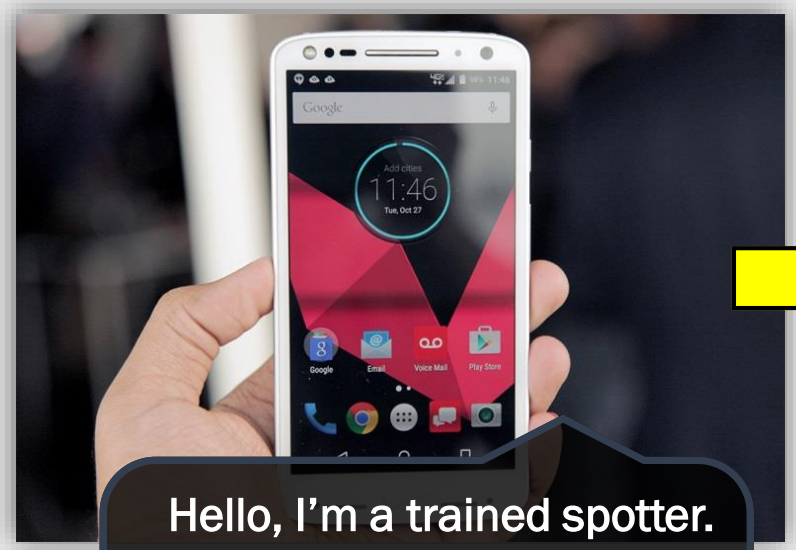
- Use what is around you as a guide to estimate depth
- Is the water standing or flowing?
- Is the flood water threatening lives or property?

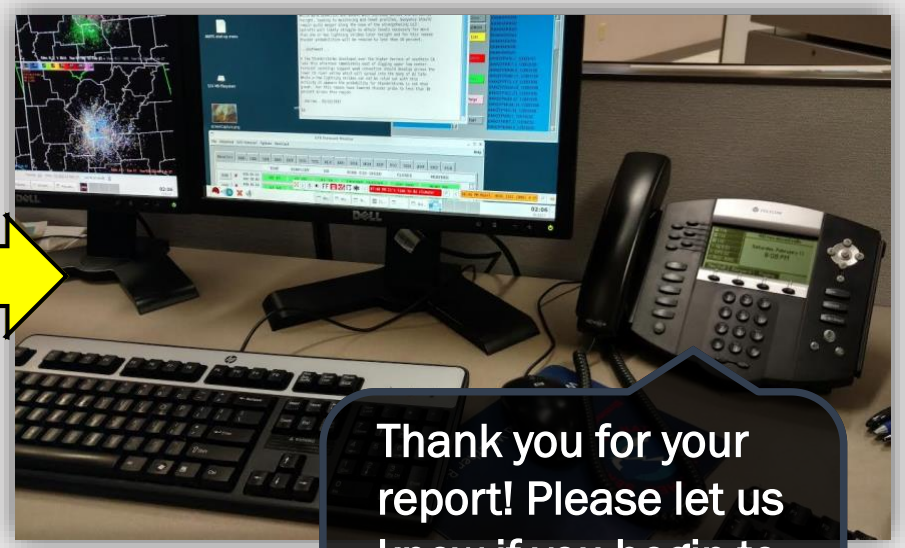
What to Report
--Wall Cloud, Funnel Cloud, Tornado--

Definitions and additional information coming up in ‘storm structure’ section!

How to Get your Report to Us Via Phone…

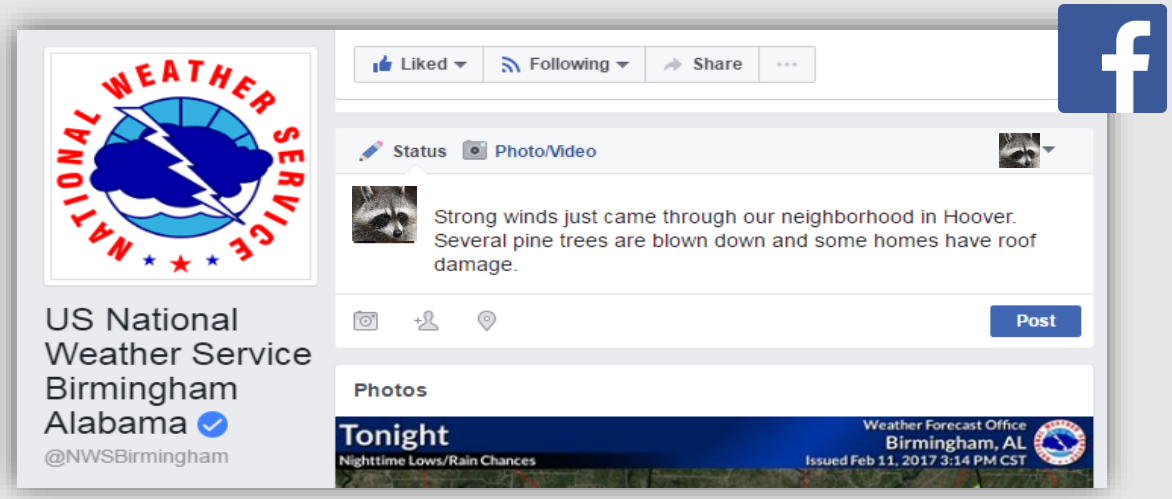
- Phone: 205-664-3010, option 2

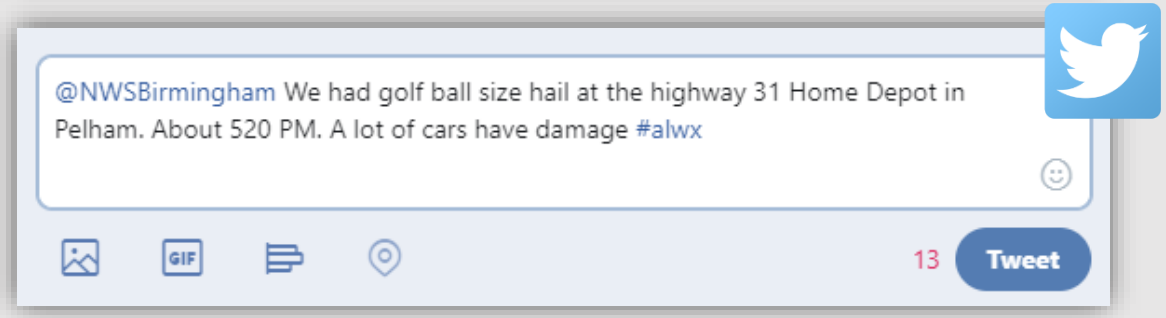




How to Get your Report to Us Social Media (Facebook or Twitter)…

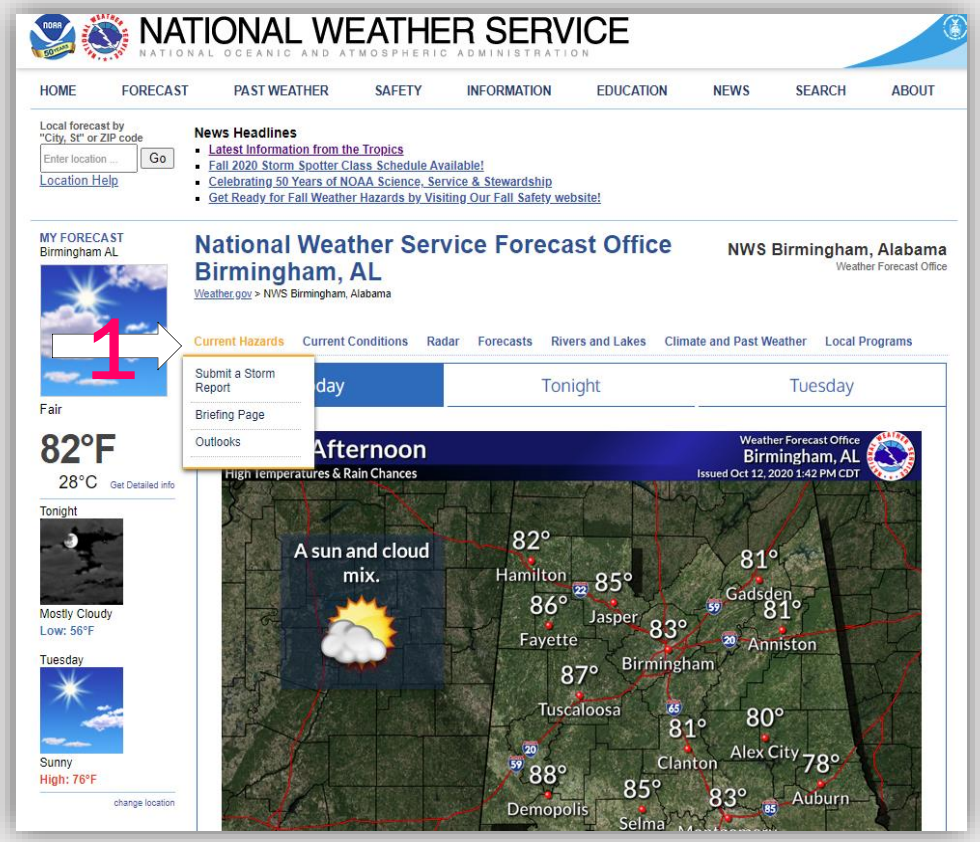
- Social media are part of our severe weather operations!

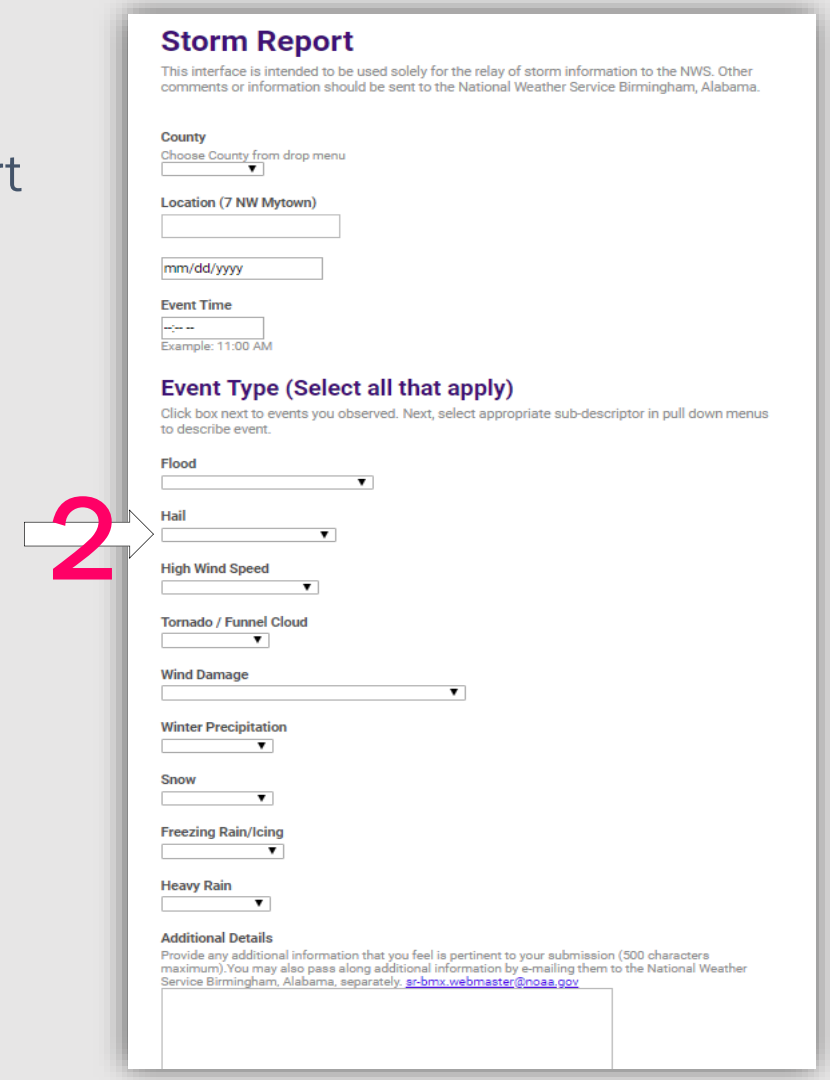




How to Get your Report to Us Our Webpage…

- weather.gov/bmx | weather.gov/bmx/submit_storm_report





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Stay Safe While Storm Spotting --Mobile--

- Remain aware of the situation around you --*weather, roads, and traffic!*
- Have an escape route --*know the storm's movement and keep distance*
- Spot with a partner --*an extra pair of eyes is good*
- Avoid: the most intense part of the storm, spotting at night, urban areas, being too close
- Obey traffic laws --*and do not stop or park on the roadway!*
- Do not get tunnel vision --*there are may dangerous weather elements other than the one you are focused on. Surprises happen!*

Weather Safety
--Lightning--

- Lightning can strike 10-15 miles away from a thunderstorm. It can be deadly!
  - *It does not need to be raining where you are for you to be struck!*
- Move inside a building; avoid appliances and metal surfaces
- Stay in a hard-topped vehicle
- If outside and without shelter, crouch down low (do not lie flat); avoid: tall objects, bodies of water, elevated areas, objects that can conduct electricity

Weather Safety
--Flooding--

Flooding is a leading cause of weather-related deaths in the U.S.

- Never cross water-covered roadways

  -The road could be washed out or compromised under the surface

  -There could be underwater obstructions or other unseen hazards … ditch?

- Get to higher ground
- Never cross barriers
- Flood dangers are harder to recognize at night


WHEN
FLOODED
TURN AROUND
DON'T
DROWN

Weather Safety --Tornado--

- Shelter in an interior room on the lowest floor of a sturdy building, and cover yourself. Avoid large/open rooms, windows
  - *Mobile or manufactured homes are not good options. Leave for a more substantial shelter ahead of time*
- *Avoid traveling when a tornado warning is in effect. Find shelter; buckle up, duck and cover; or find a ditch. Don't go under a bridge.*



5-MINUTE BREAK

Next: The Goods.

Thunderstorm formation, Types, Structure, and Identification

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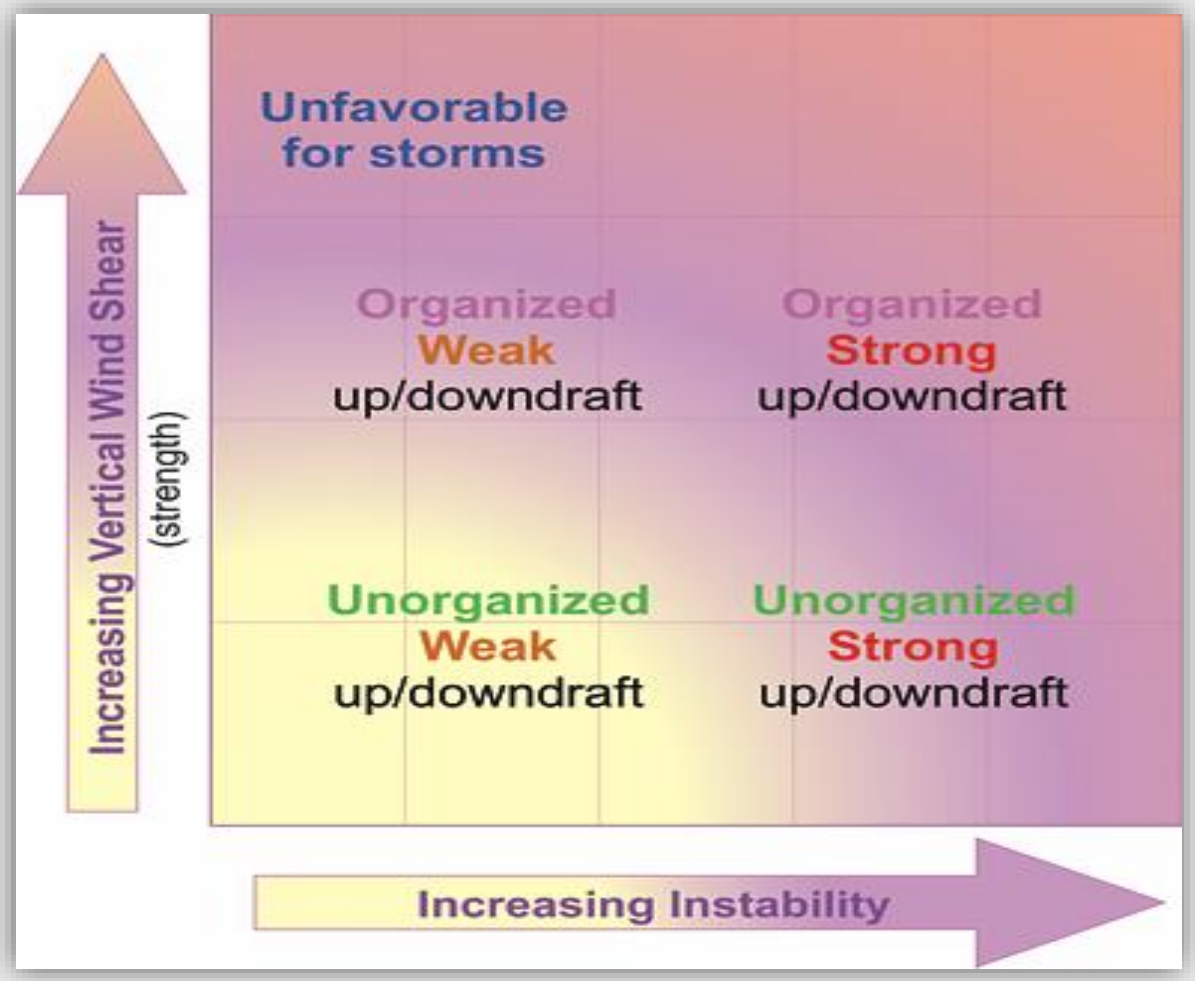
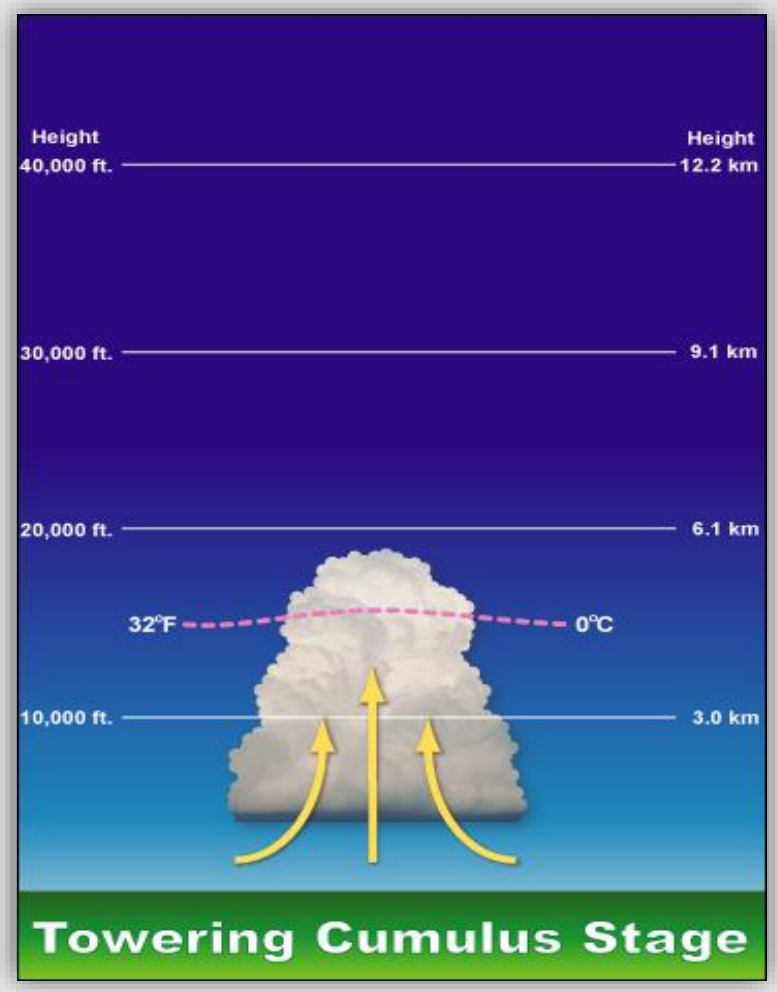
Ingredients for Thunderstorm Formation

- Source of lift
  - *Cold front*
  - *Warm front*
  - *Gust front/outflow*
  - *Terrain (upslope flow)*
  - *Surface heating*
- Moisture
- Instability

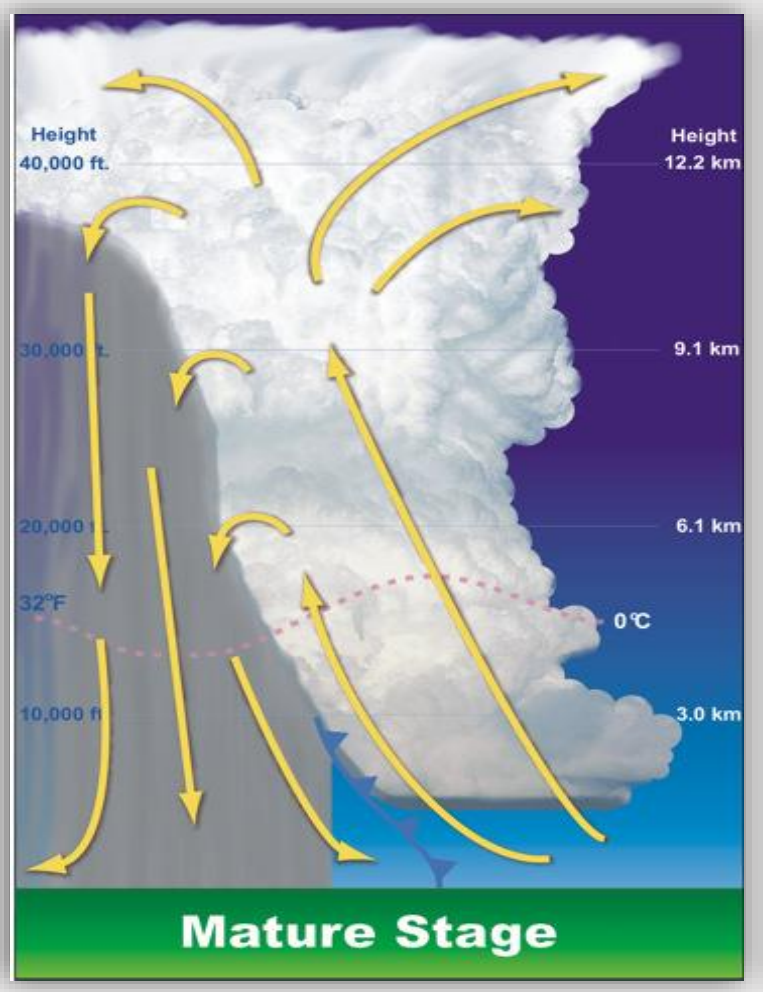
*Wind shear helps with thunderstorm organization, longevity, and potential severity



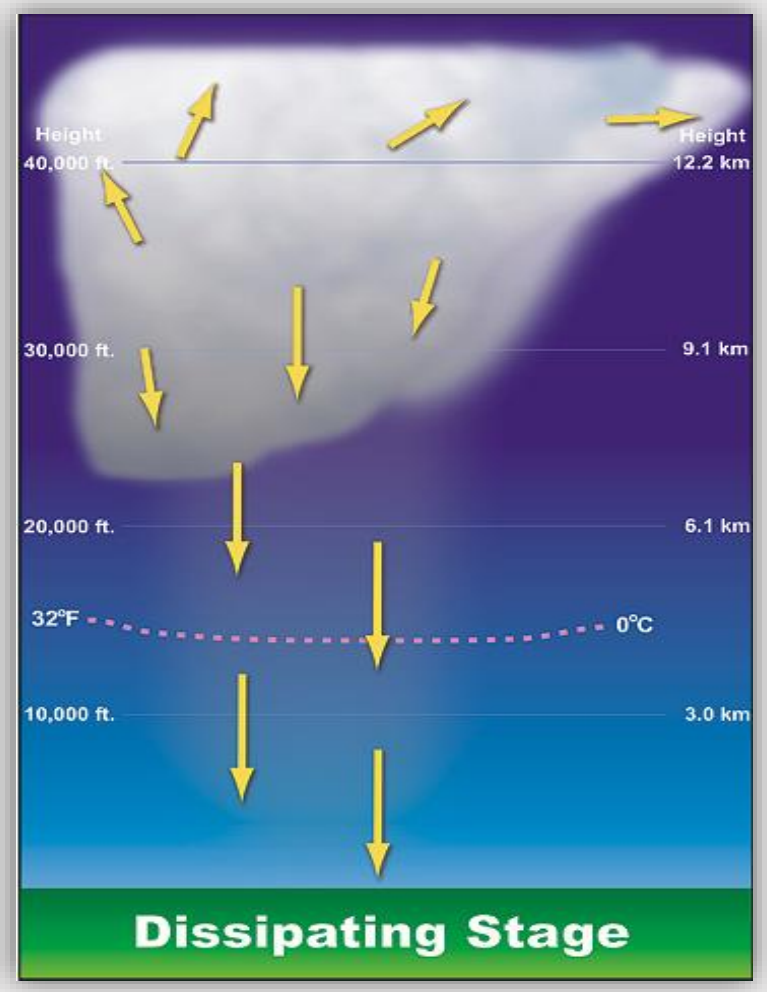
Thunderstorm Stages



- Updraft dominates
- Cumulus cloud grows vertically
-Up to ~20,000 feet tall



- ~40,000 to 60,000 feet tall
- Strong updraft and downdraft coexist
- Large hail, damaging winds, tornado(es), and flooding rain may occur



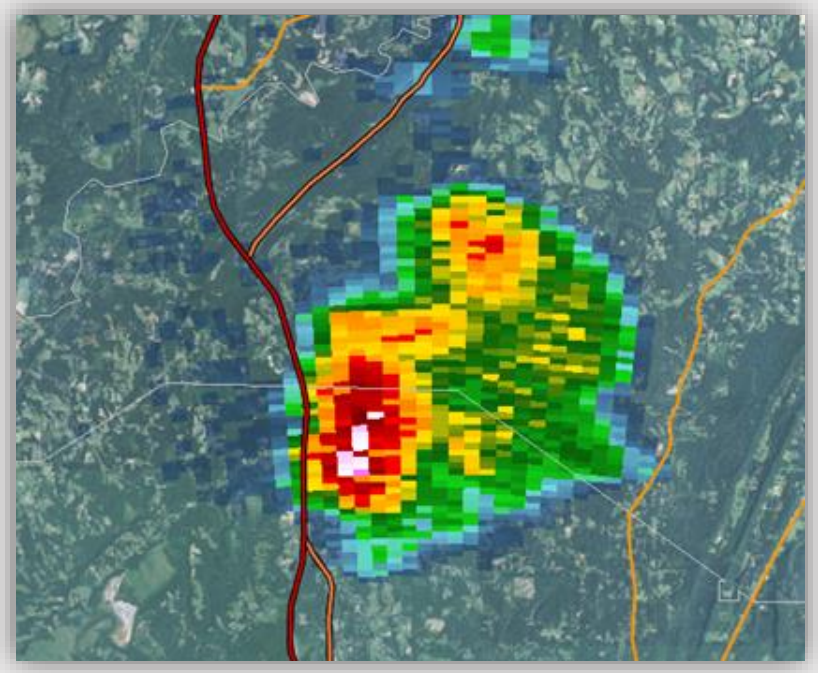
- Downdraft cuts off updraft
- Rain, gusty winds, and last lightning strike
- Remnant anvil cloud aloft

Types of Storms

- Single cell
- Multicell
  - *Cluster*
  - *Line*
- Supercell
  - *Classic*
  - *Low precipitation (LP)*
  - *High precipitation (HP)*
  - *Mini supercell*

Thunderstorm Types --Single Cell--

- Rather short-lived and unorganized
- Can be random in time and location
- No or low severe weather threat
- Characteristics:
  - *Gusty wind*
  - *Small hail*
  - *Heavy rain*
  - *Lightning*

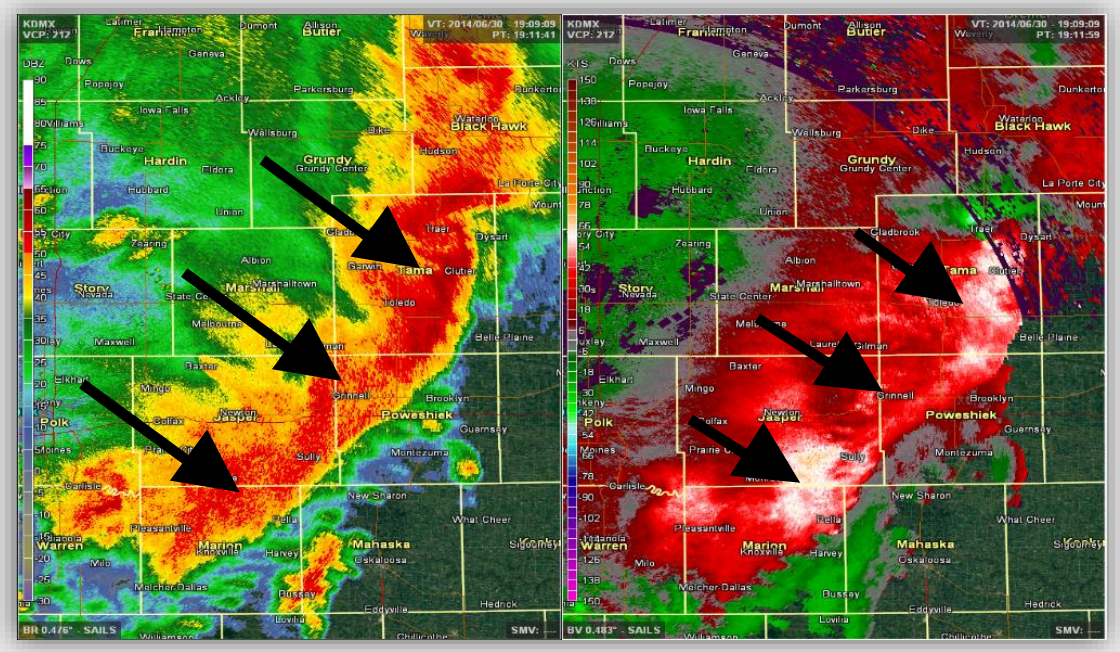


Thunderstorm Types --Multicell Cluster--

- Several storm cells in a group, with each in a different lifecycle stage
- Low to moderate severe weather threat (depends on environment)
- Characteristics:
  - *Heavy, flooding rain*
  - *Gusty, sometimes damaging wind*
  - *Small to large hail*
  - *Lightning*

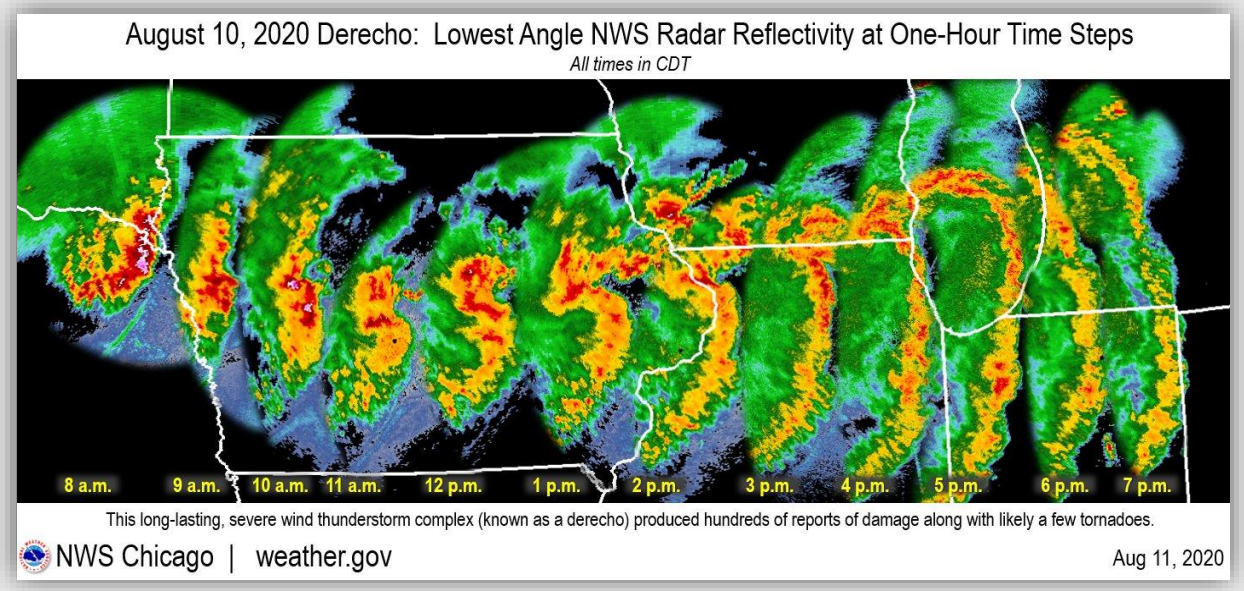
Thunderstorm Types --Multicell (Squall line)--

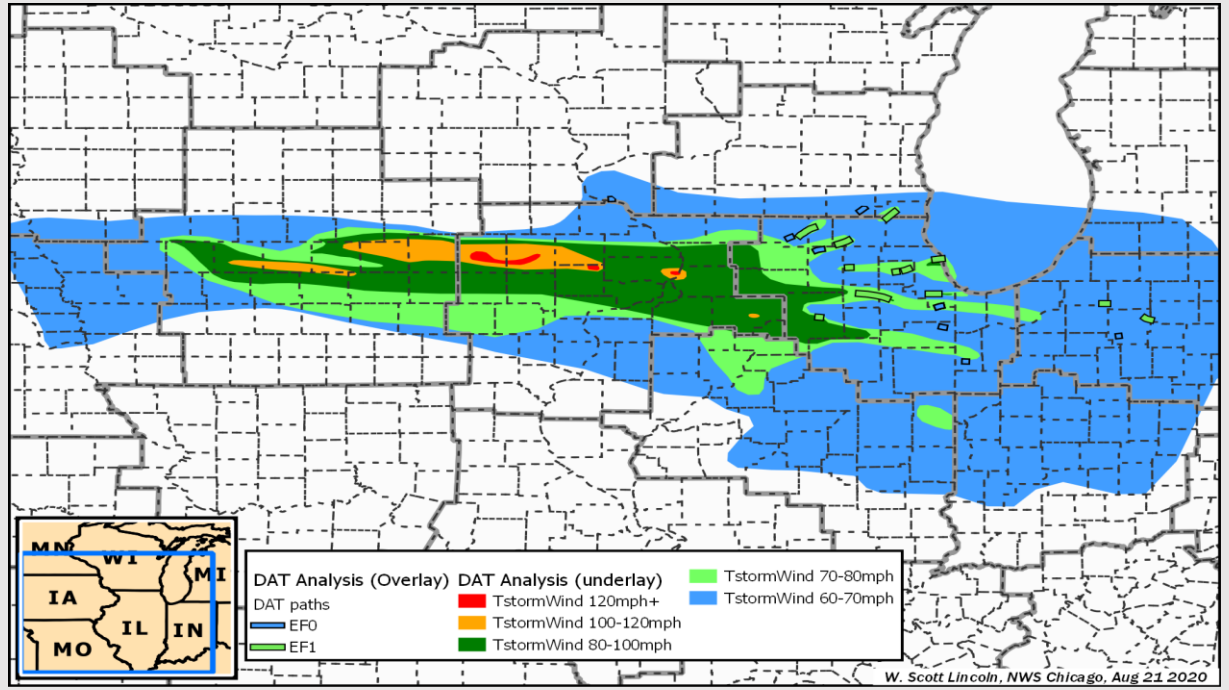
- Several storms organized into a linear structure
- Low to high severe weather threat (depends on the environment)
- Characteristics:
  - *Gusty to damaging wind*
  - *Weak to strong tornadoes*
  - *Small to large hail*
  - *Flooding rain*
  - *Lightning*



Thunderstorm Types
--Derecho--

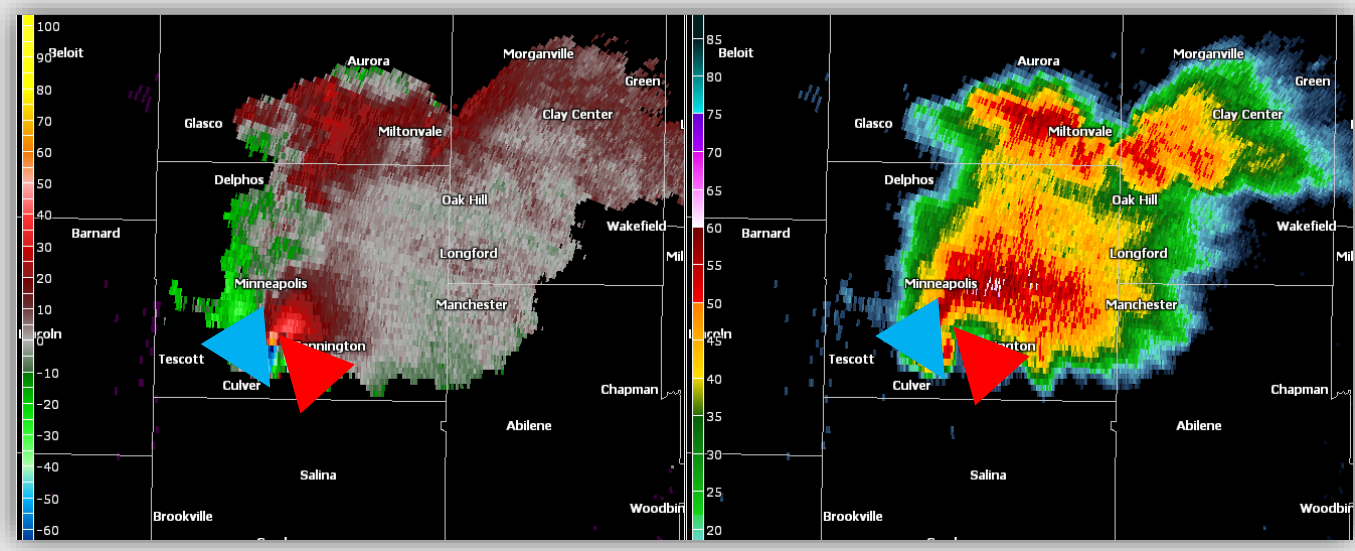
- A powerhouse type of squall line
- Wind damage and/or 58 MPH+ wind over a 250+ mile track
- High severe weather threat
- Characteristics:
  - *Swaths of destructive wind*
  - *Significant wind gusts*
  - *Weak to strong tornadoes*
  - *Small to large hail*
  - *Flooding rain*
  - *Lightning*



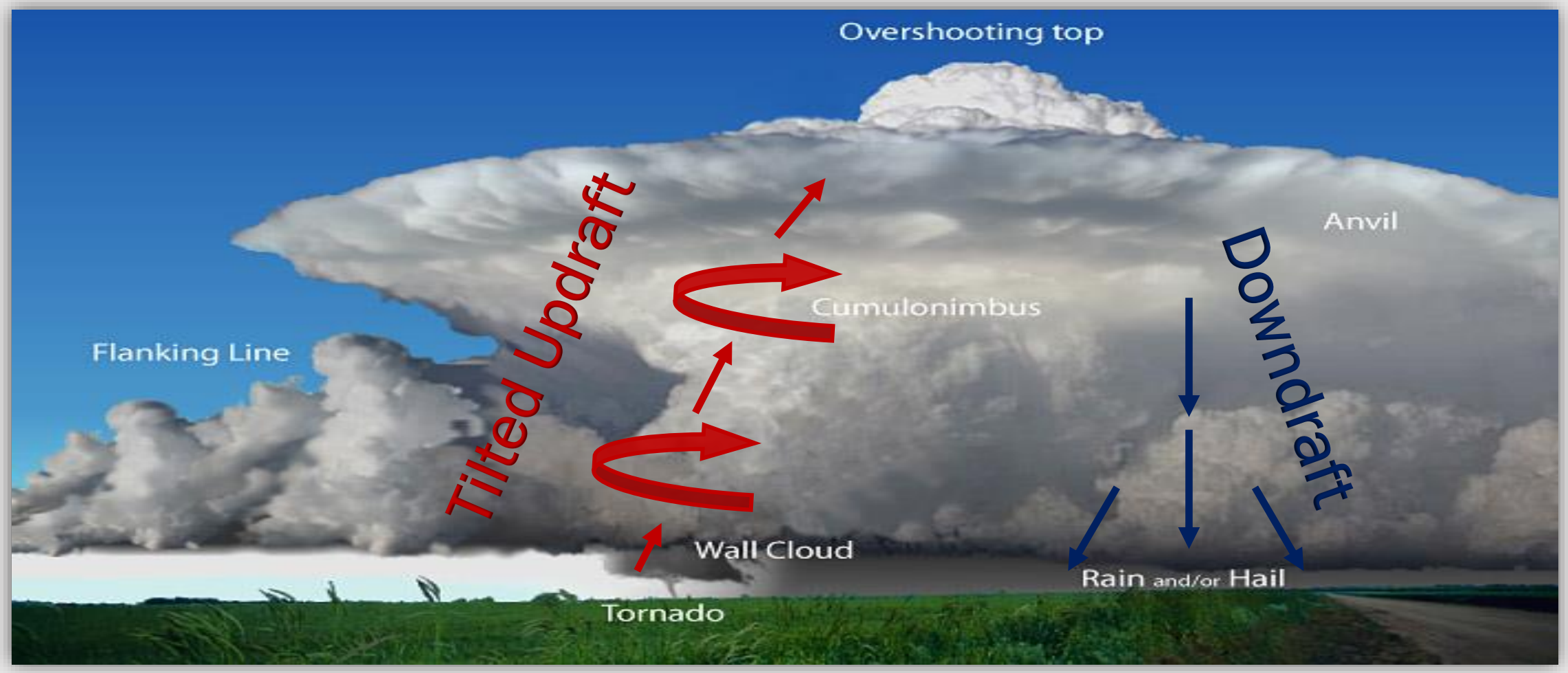


Thunderstorm Types --Supercell--

- Supercell storms have a **rotating updraft**
  - *Can form a sculpted, barber pole structure depending on visibility*
- Moderate to high severe weather threat
- Characteristics:
  - *Weak to strong tornadoes, sometimes long-track*
  - *Small to giant hail*
  - *Damaging winds*
  - *Flooding rain*
  - *Lightning*



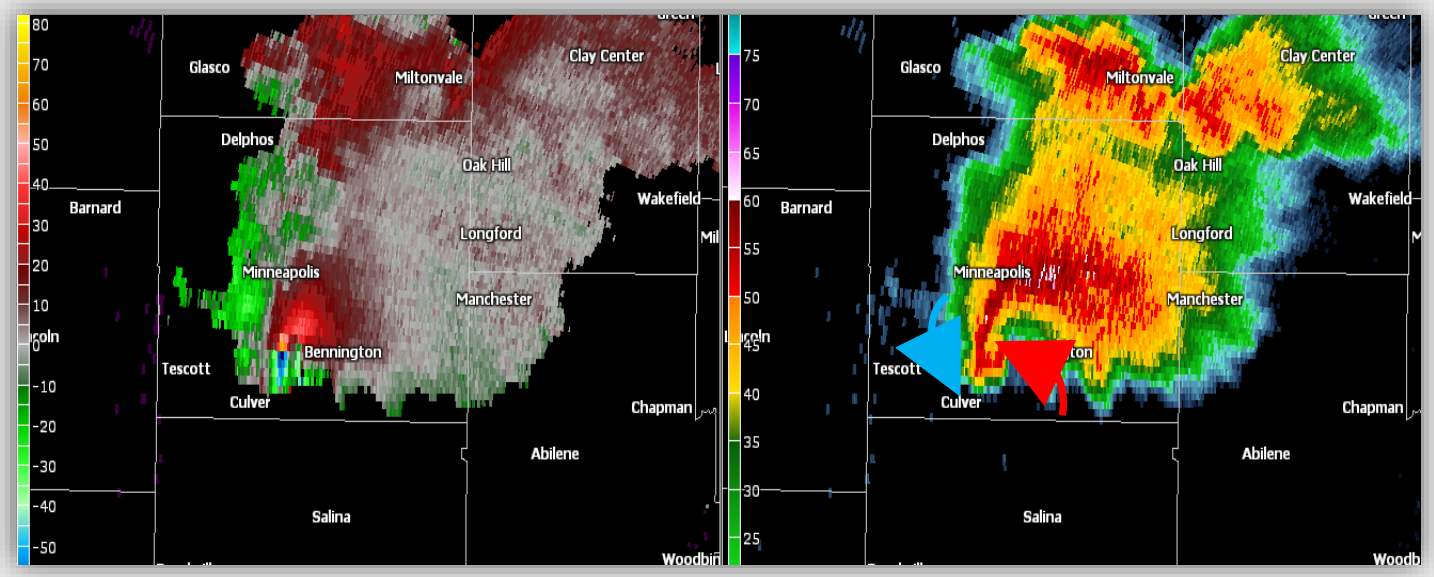
Supercell Thunderstorm Structure Profile View

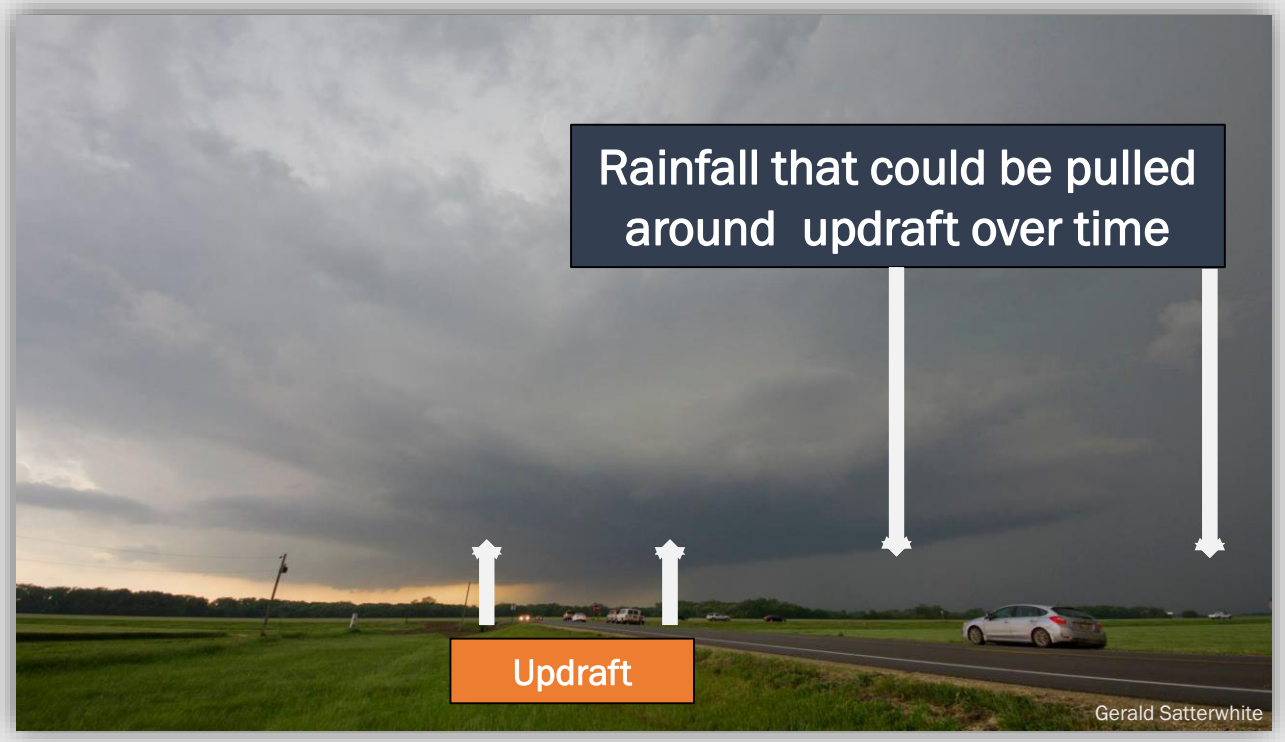


Updraft = rising air | Downdraft = sinking air

Supercells --Classic--

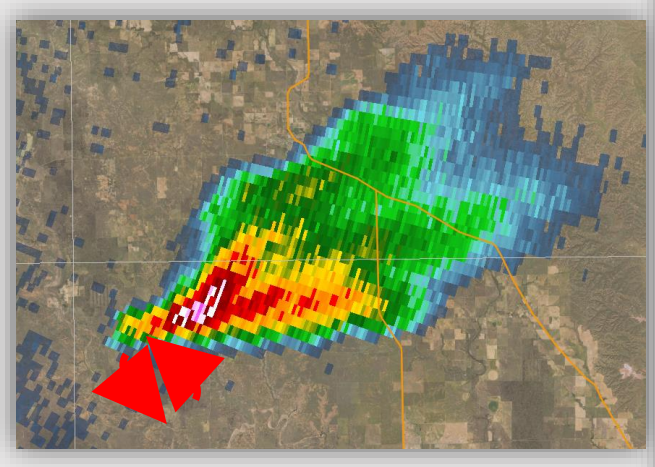
- Rotating and visible updraft
  - *Precipitation can eventually be pulled around the updraft, obscuring it*
- Prominent hook echo on RADAR
- Observed in Alabama

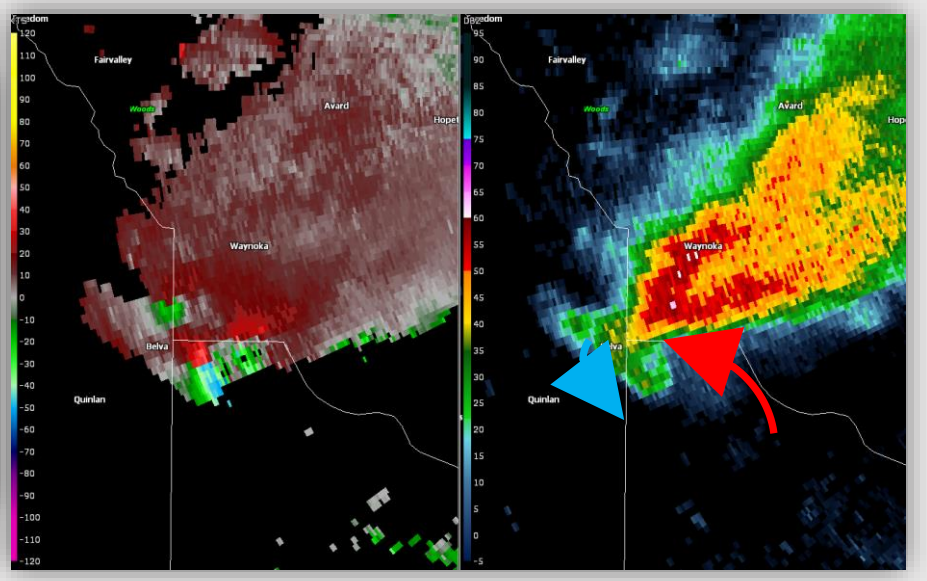




Supercells
--Low Precipitation (LP)--

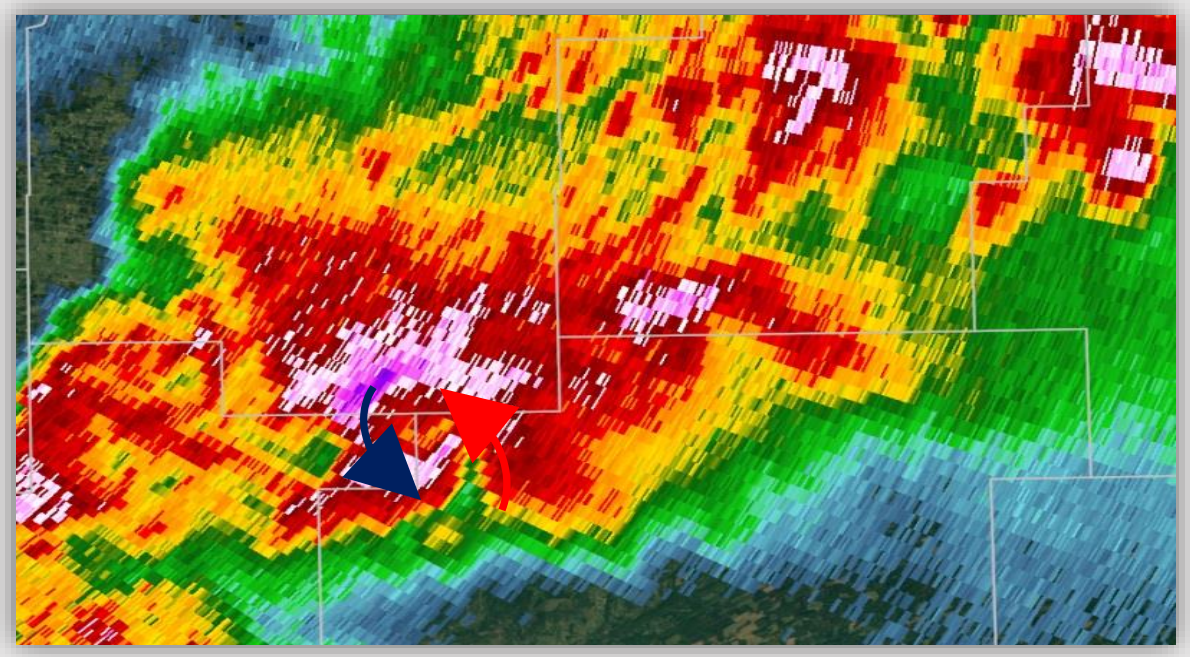
- Rotating and highly visible updraft
  - *Little rain/hail in the vicinity*
- Hook echo may not be visible on RADAR, or may be very faint
- Rare in Alabama



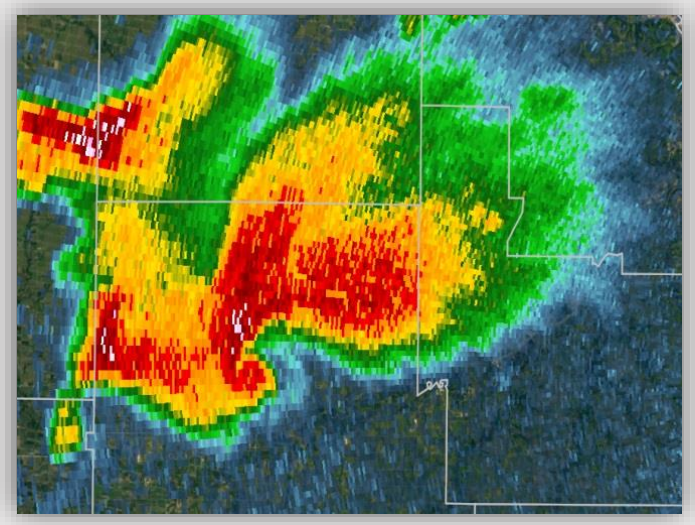


Supercells
--High Precipitation (HP)--

- Heavy precipitation obscures the rotating updraft
  - *Impossible to make out features. Very dangerous for spotters!*
- Common in Alabama
- In some cases, it can be hard to see the hook echo on RADAR reflectivity w/o the aid of velocity

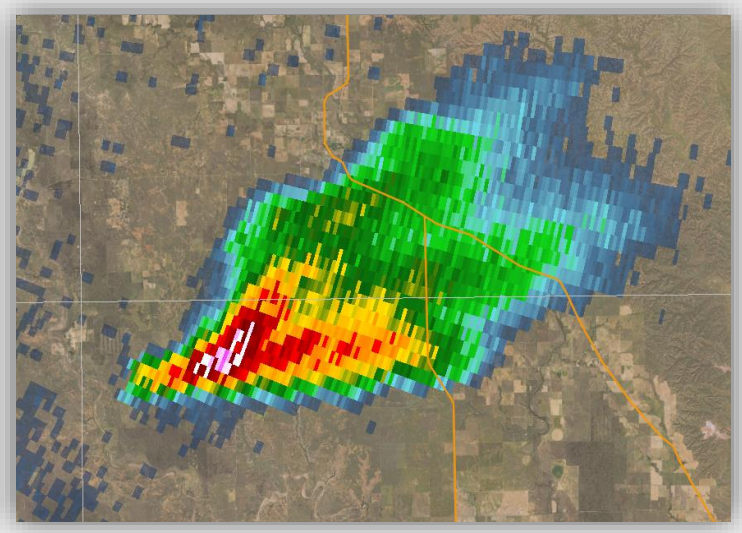


Supercell Type Recap



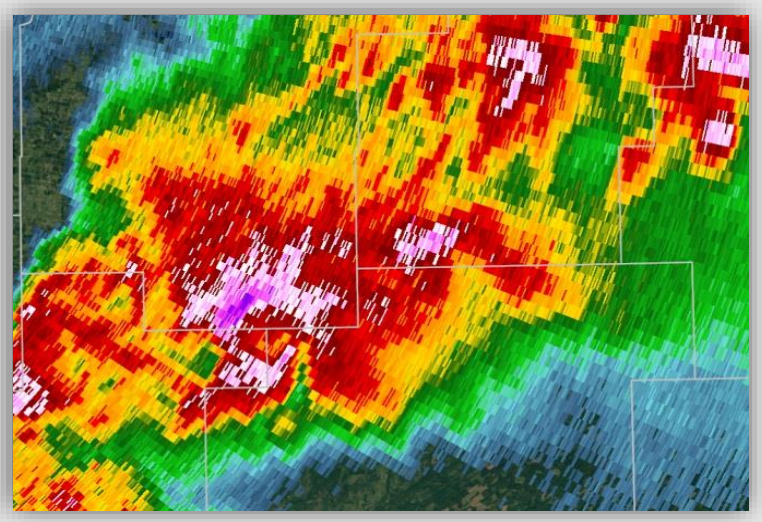
Classic

>> Updraft (and tornado if occurring) visible, but could become rain-wrapped with time



Low Precipitation (LP)

>> Updraft (and tornado if occurring) highly visible through its lifecycle

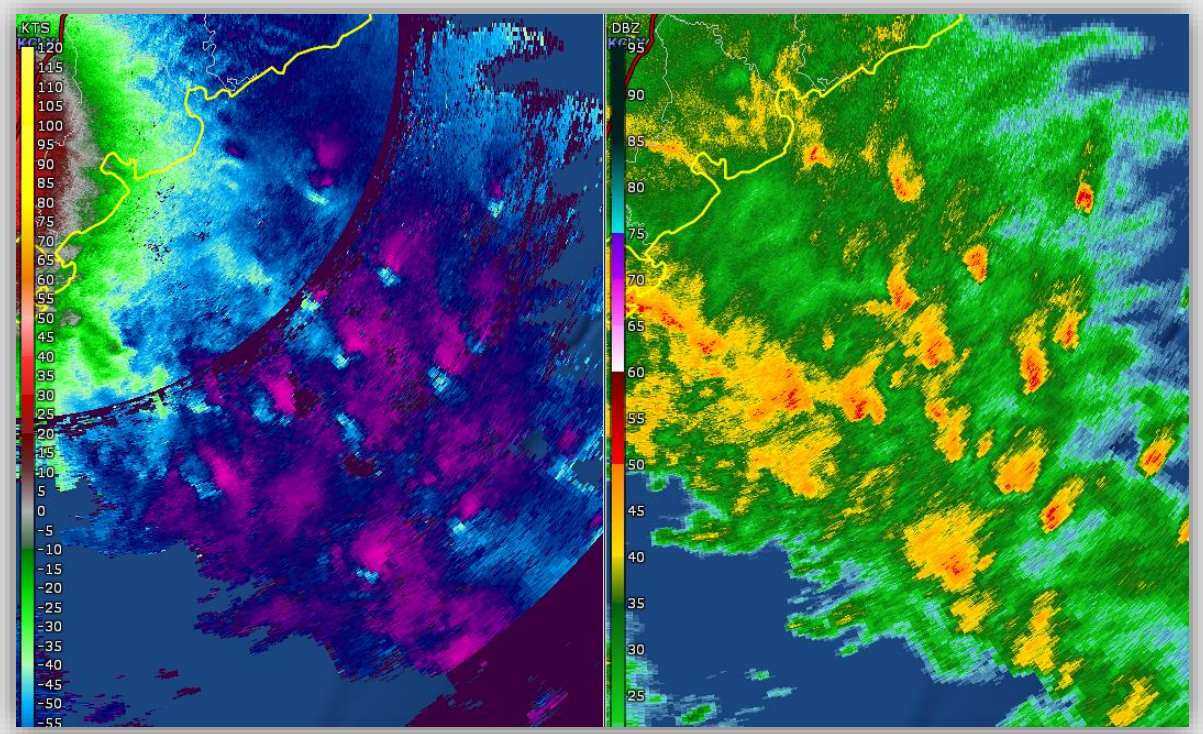


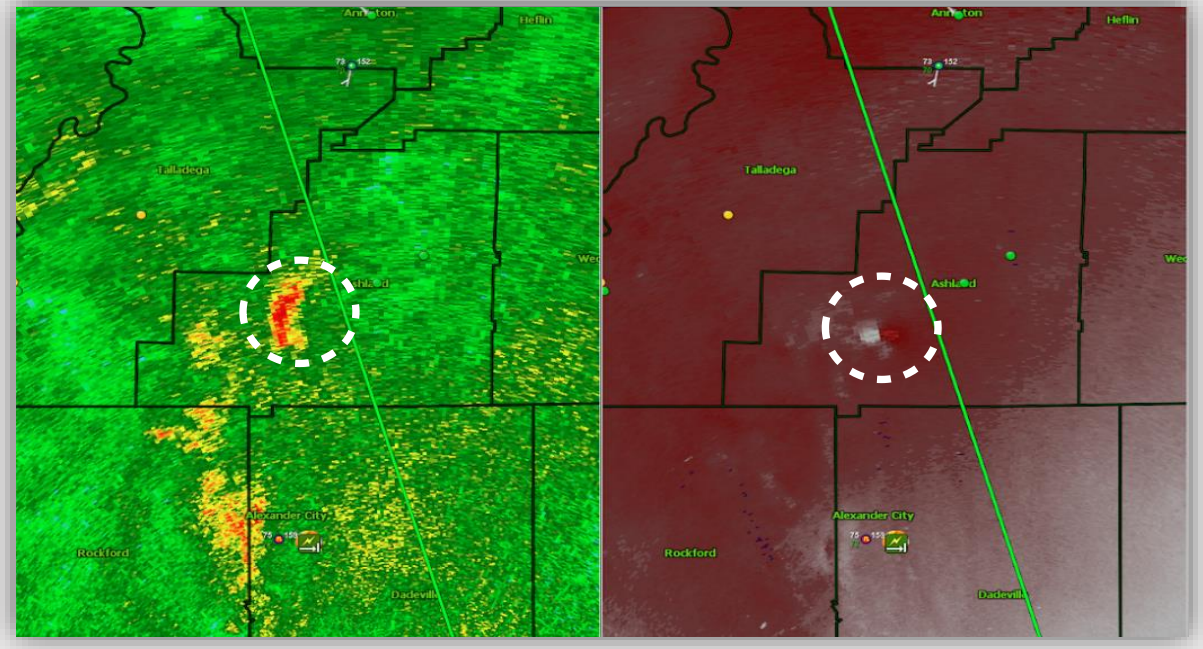
High Precipitation (HP)

>> Updraft (and tornado if occurring) are rain-wrapped

Supercells
--Mini--

- Smaller and much shallower
- Common in tropical systems and cold season weather systems
- Can be embedded within a large rain shield
- Characteristics:
  - *Usually low-end, brief tornadoes*
  - *Very little or no lightning*





Spotter Training Outline

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Part I

- Who is the National Weather Service (NWS) and why we need spotters
- Severe weather stats and definitions
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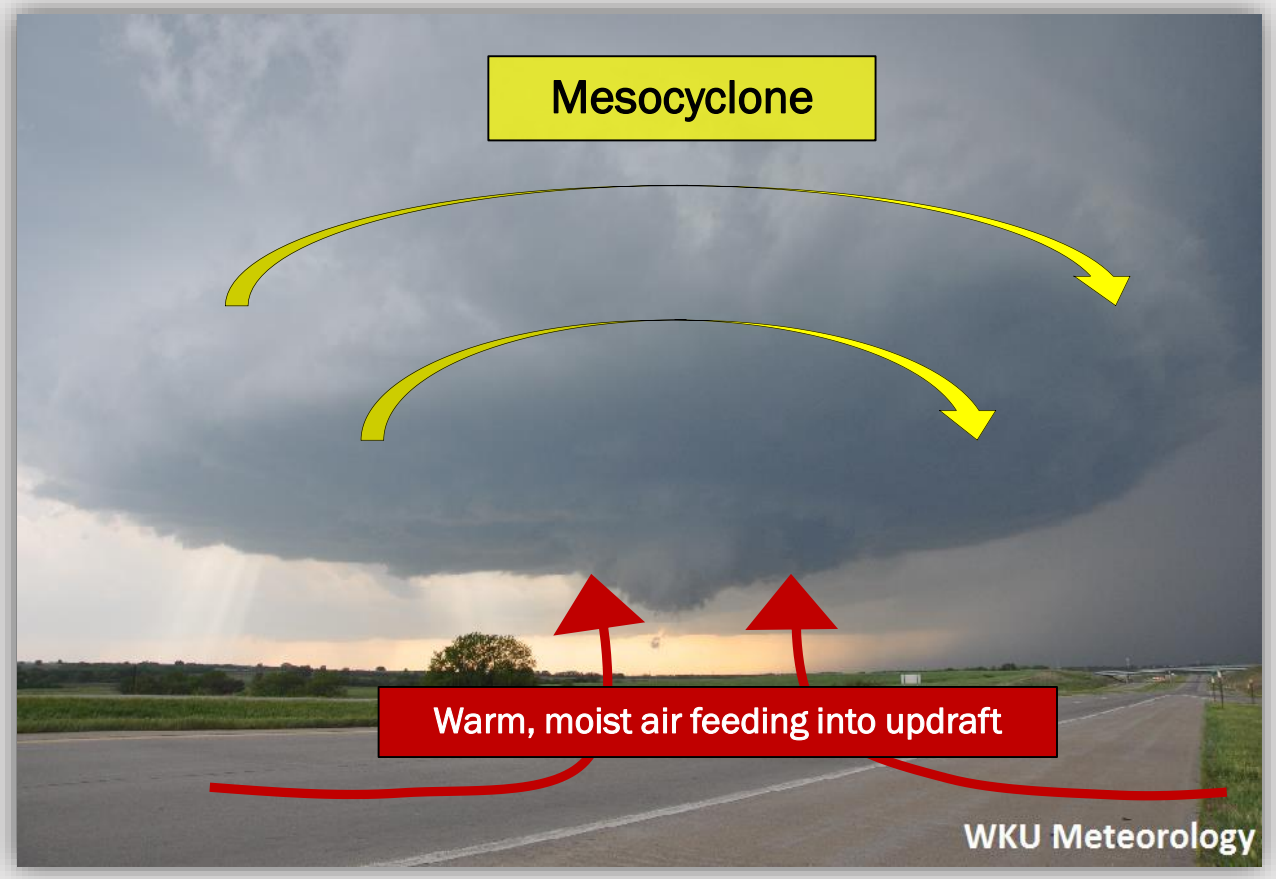
Part II

- Thunderstorm development and types
- Thunderstorm structure
- Tornado development
- Report what you see photo polls
- Spotter information recap

Thunderstorm Structure --Mesocyclone--

- Storm-scale area of rotation
  - *Look for curvature*
- The wall cloud, funnel cloud, and tornado form underneath the mesocyclone
- Don't confuse the mesocyclone with a rain-free base of an ordinary storm.

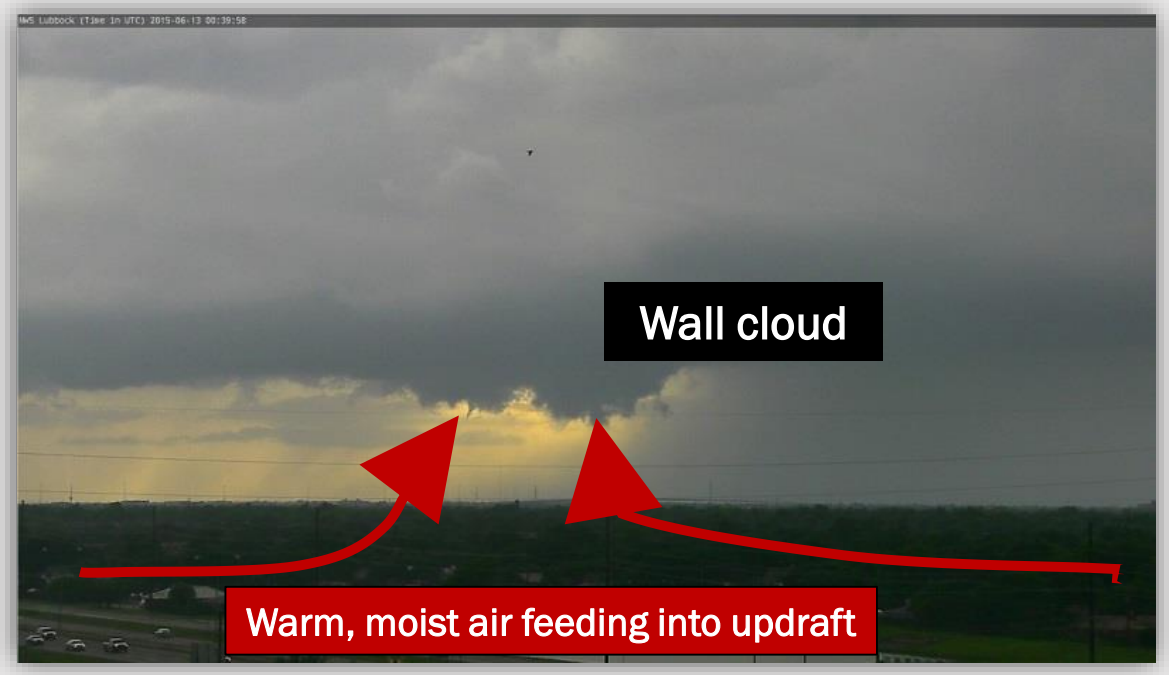
*Not all storms will have a clearly defined mesocyclone, visually



Thunderstorm Structure --Wall Cloud--

- An attached, persistent, and blocky lowering from the storm's updraft base
- A region of surface-based inflow
- May exhibit rotation and upward motion if beneath a mesocyclone
  - *Not all wall clouds rotate, and most rotating wall clouds do not produce a tornado*
  - *Ordinary storms can have a wall cloud, simply an inflow area*

*Not all storms have a clearly defined wall cloud, visually



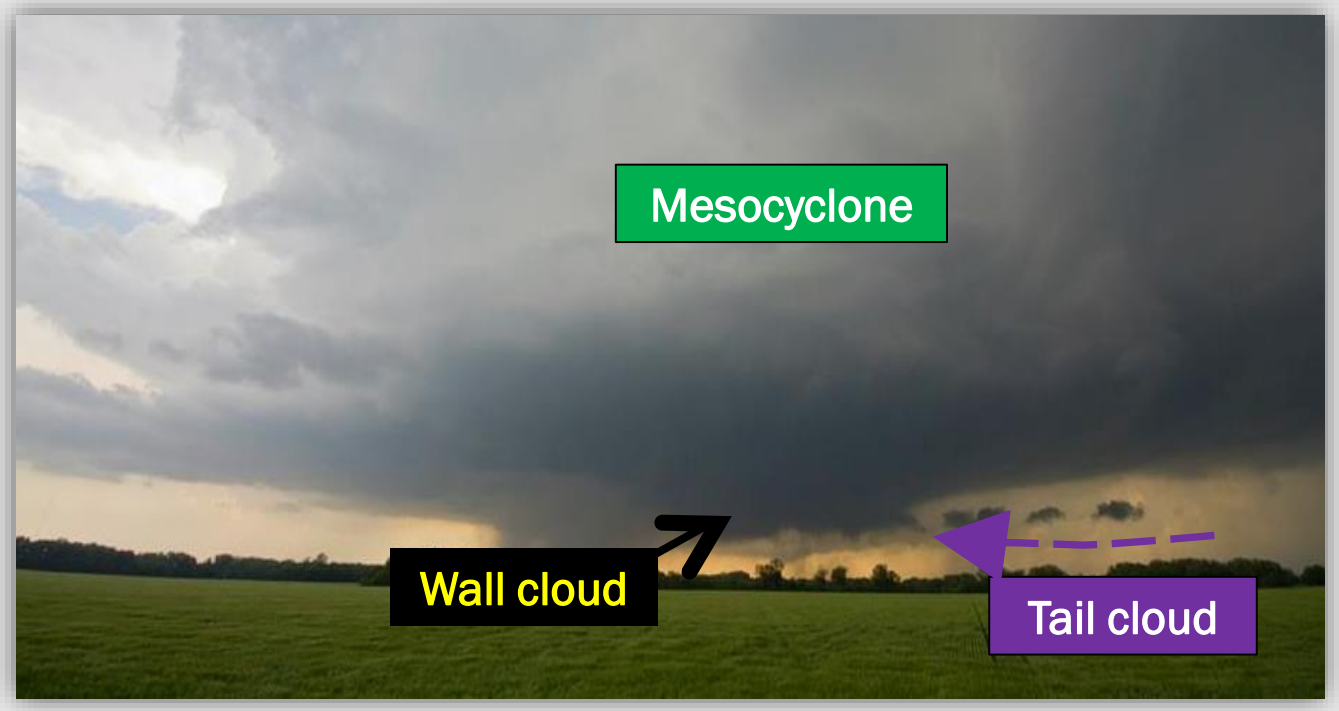
Thunderstorm Structure --Scud Clouds--

- Unattached, ragged, low-hanging cloud fragments
- Form via interaction of rain-cooled air and surrounding warm air
- They do not rotate; thus, not a funnel cloud and not a tornado. Don't get tricked!

Sometimes, scud form near and rise into a storm's updraft region, forming a wall cloud. This is an indicator that the storm is organizing. Watch for further development/increasing vertical motion and any rotation.

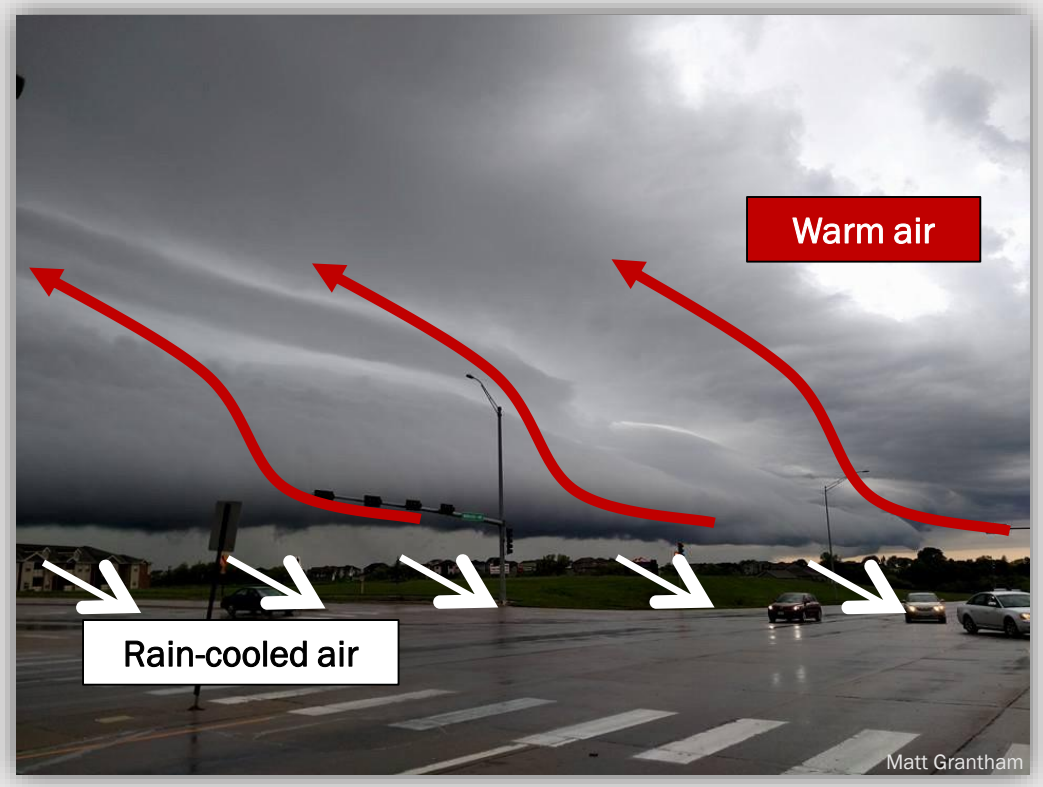
Thunderstorm Structure --Tail Cloud--

- A band of inflow feeding into the wall cloud from the main precipitation core
- Some of these may develop or trail close to the ground. Don't get tricked into thinking it is a funnel cloud or tornado!



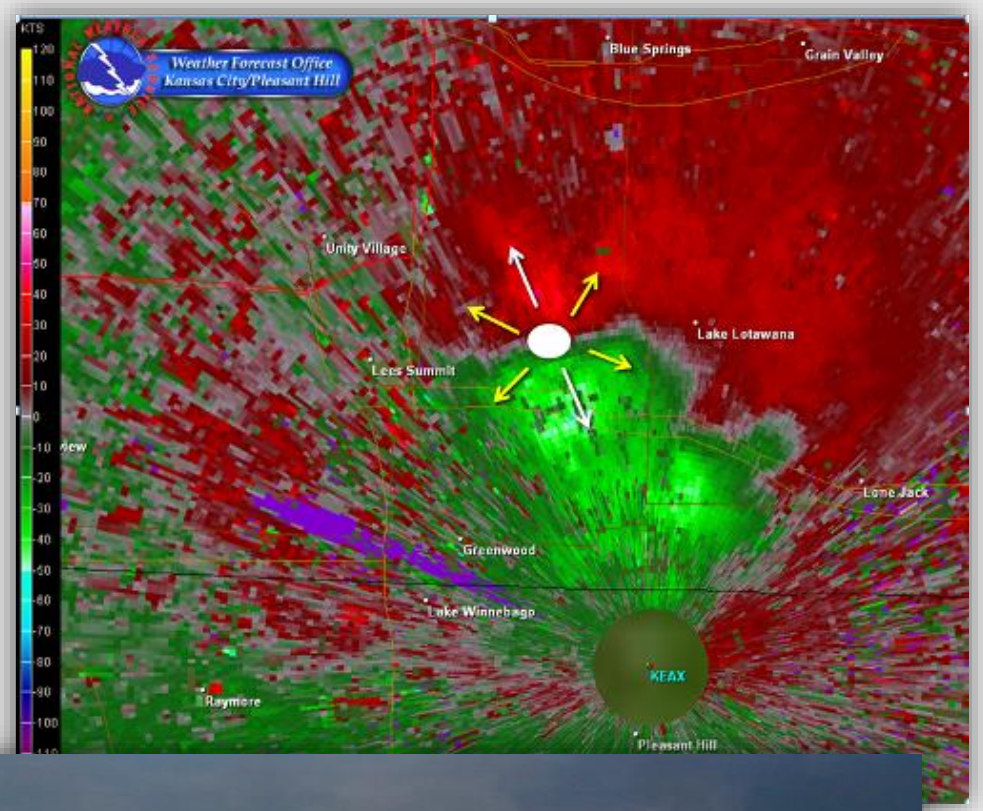
Thunderstorm Structure --Shelf Cloud--

- Marks the leading edge of the gust front
  - *Seen via a long, low-hanging, horizontal cloud*
- Often occur with a squall line and can contain strong wind
- Slopes away from the precipitation area
- An area of low-level shear
  - *You will often see turbulent eddies on the edge or underneath the shelf cloud. This turbulent motion is not associated with anything tornadic!*

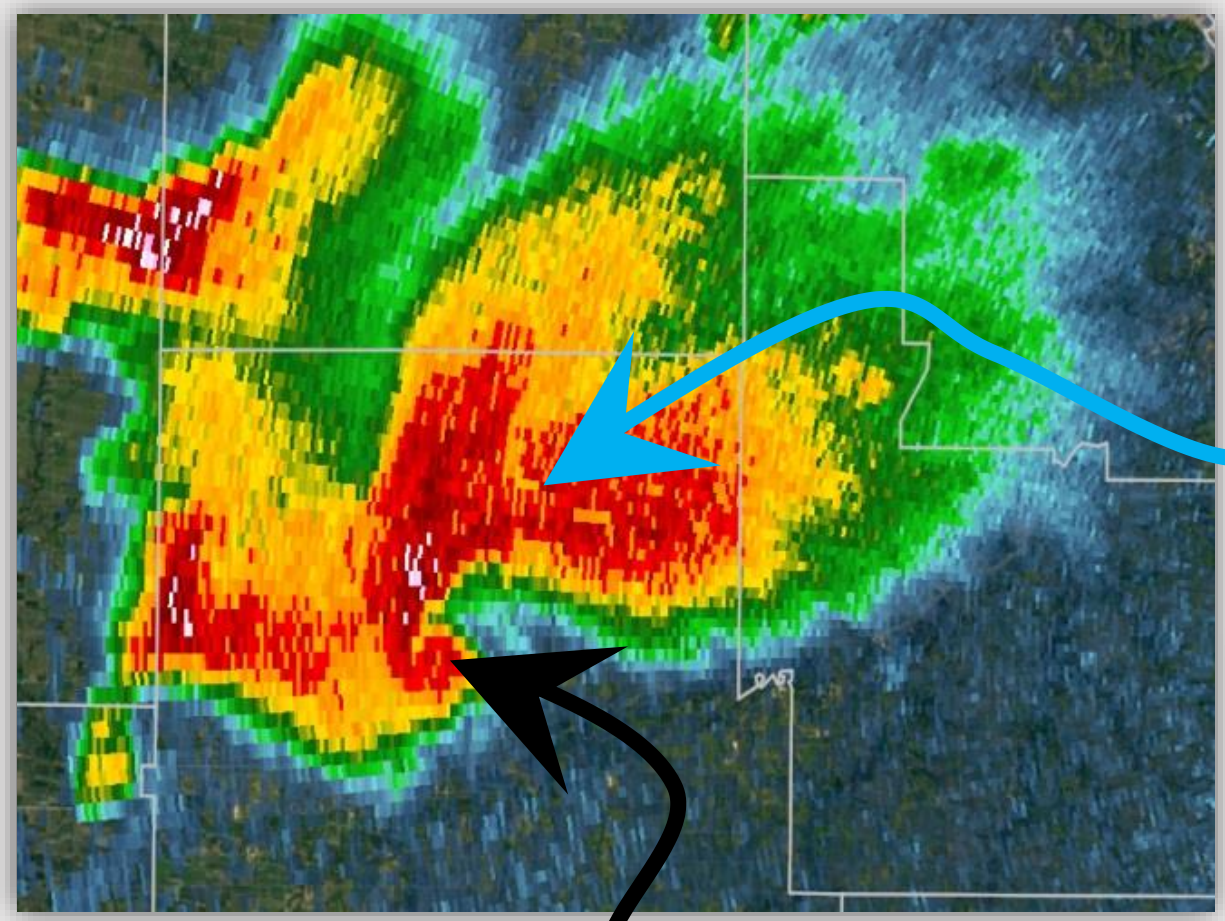


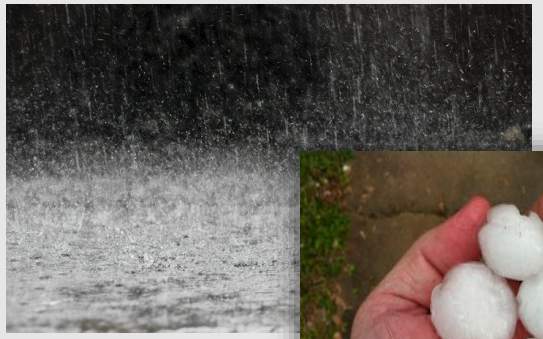
Thunderstorm Structure --Microburst--

- A downward surge of heavy precipitation and wind as the core of a storm descends
- Strong wind spreads out 360° upon hitting the ground
- Wind is straight-line, not rotating



What Part of the Storm Are You Viewing? What Kind of Storm? Very Important!





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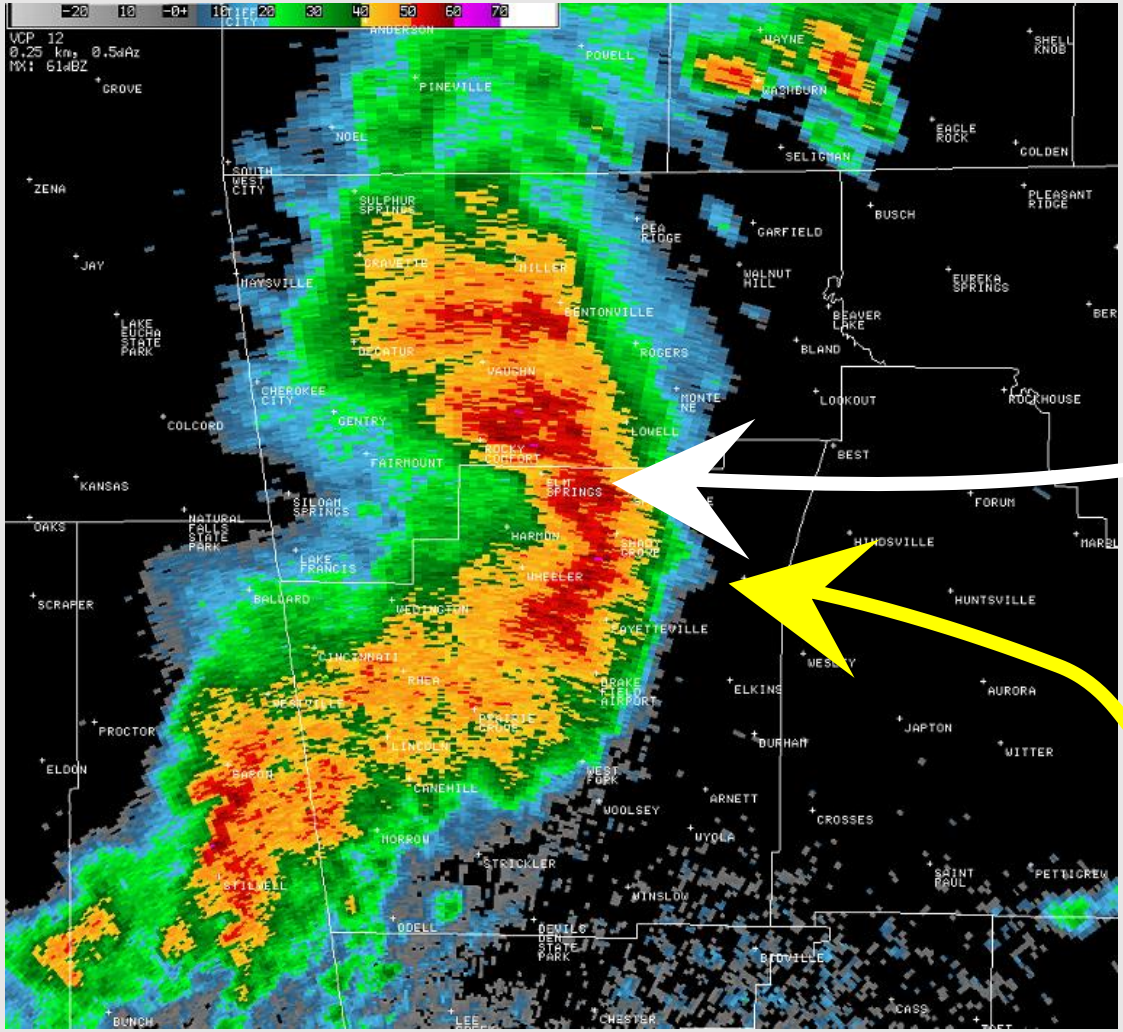

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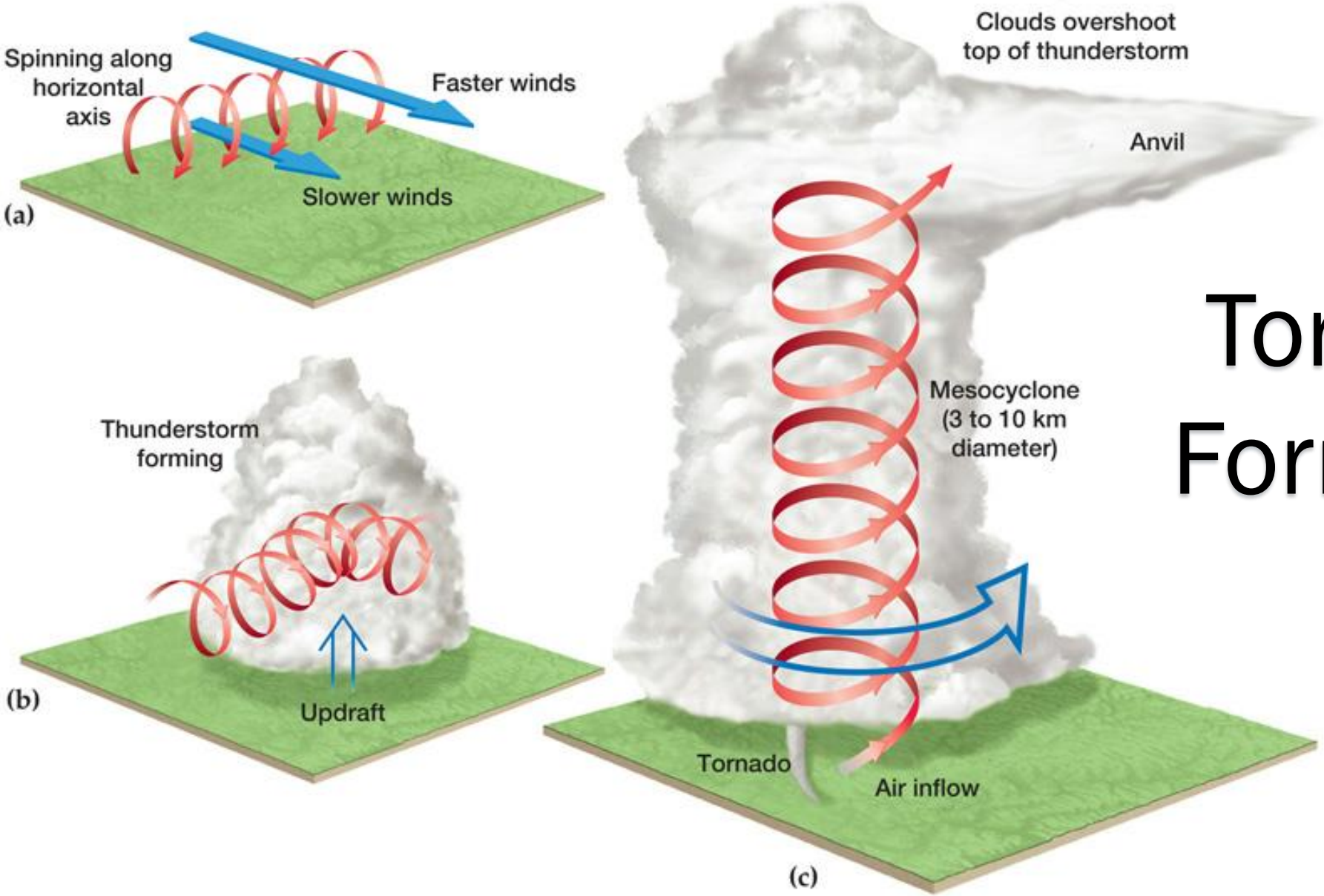
Tornado Formation



Funnel Cloud

- A rotating, funnel-shaped cloud extending from the base of a storm.
  - *The funnel is attached to the cloud base and is rotating, unlike scud*
- Commonly laminar or smooth in appearance
- Located at, and associated with, the updraft
- Funnel clouds do not reach the ground!

Tornado

- A rotating vertical column of air extending from the base of a *thunderstorm to the ground
- The condensation could (part of the tornado or funnel that you can see) may not extend all the way to the ground visually, but debris kicked up along the ground indicates contact!

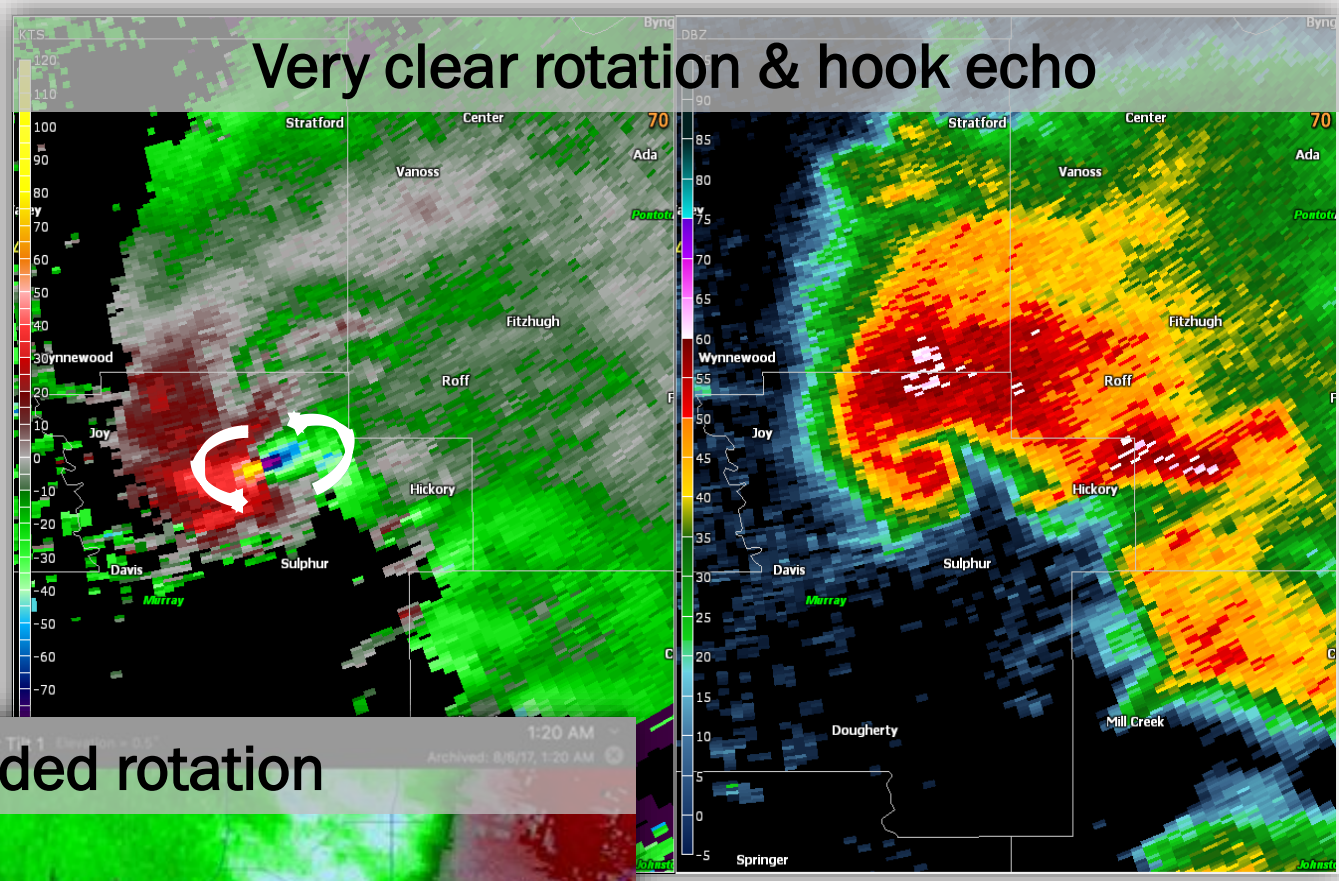
*sometimes cells with no lightning can produce tornadoes

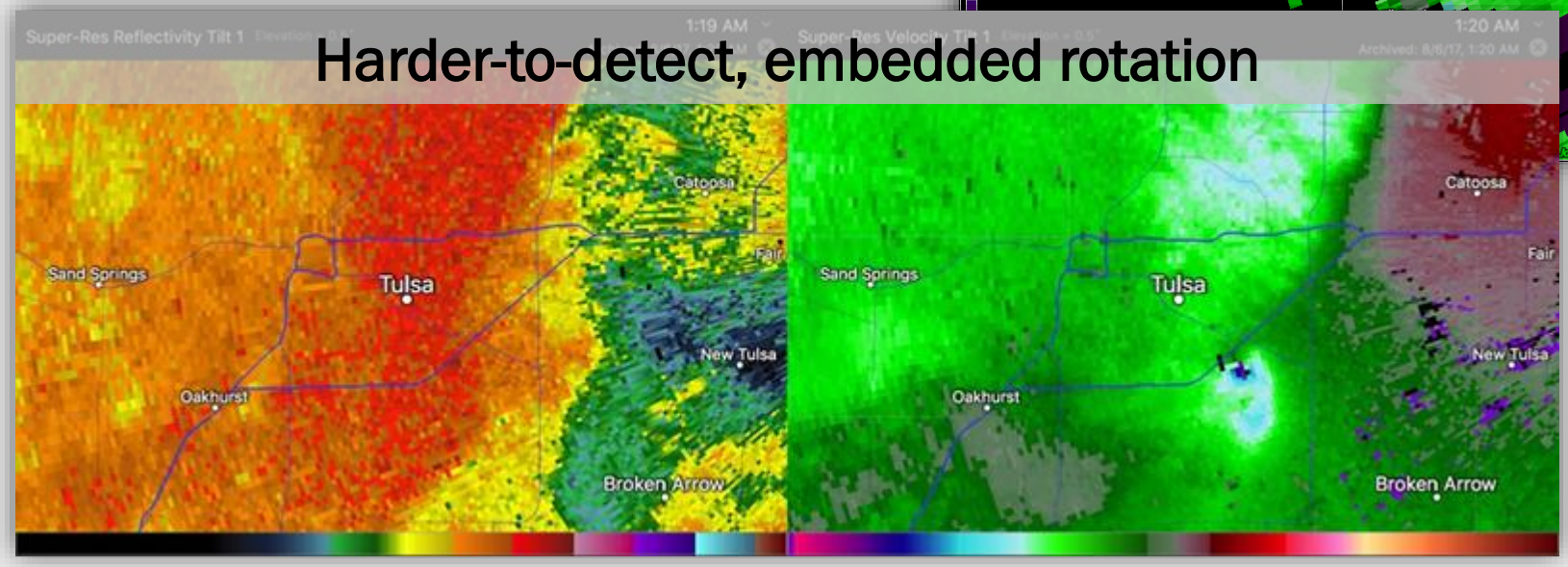
Wall Cloud -> Tornado Evolution

Real-world Evolution! [Video]

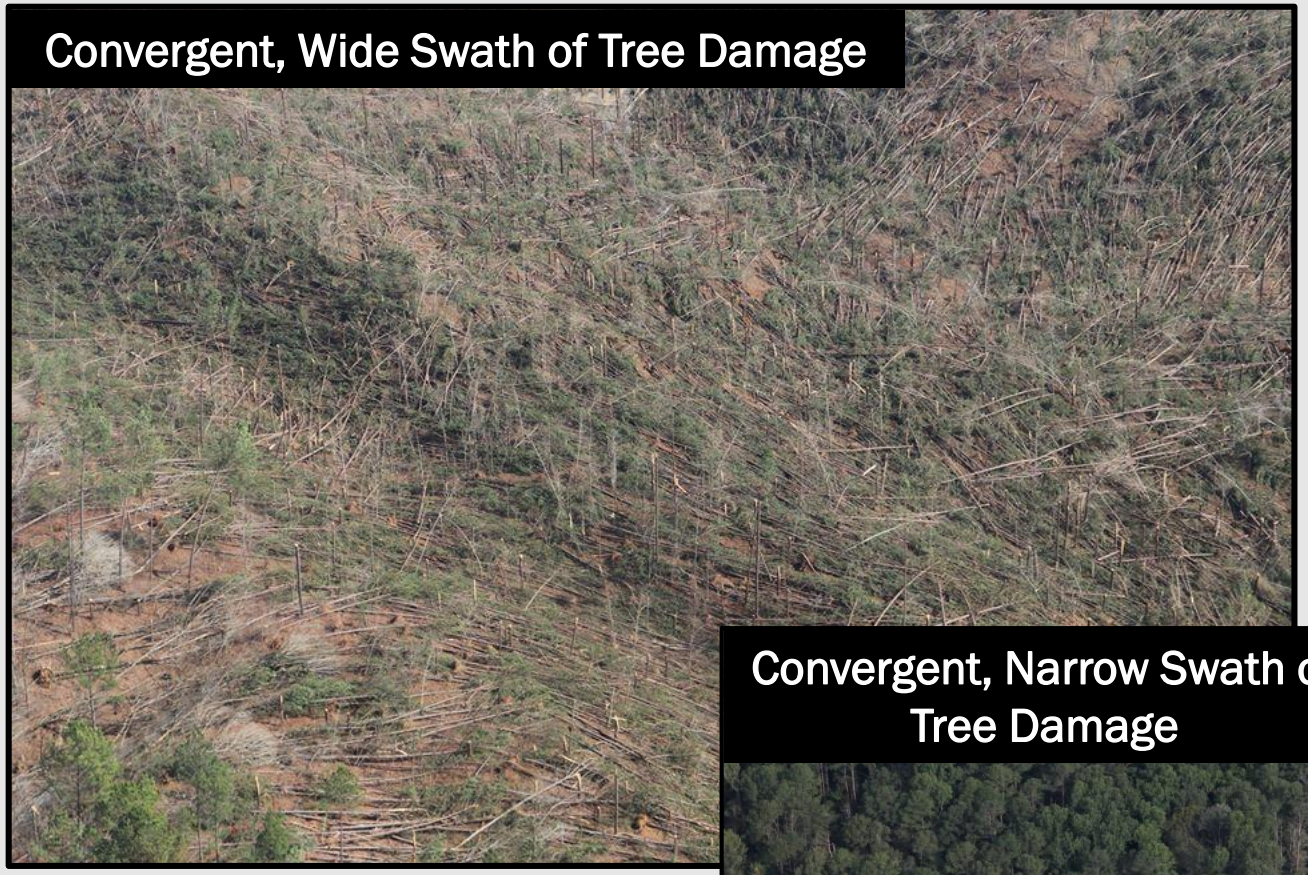
Tornadic Circulations on RADAR

Some Prominent, Others Subtle





Tornado Damage Patterns



EF Rating	Wind Speeds	Expected Damage		
EF-0	65-85 mph	'Minor' damage: shingles blown off or parts of a roof peeled off, damage to gutters/siding, branches broken off trees, shallow rooted trees toppled.		
EF-1	86-110 mph	'Moderate' damage: more significant roof damage, windows broken, exterior doors damaged or lost, mobile homes overturned or badly damaged.		
EF-2	111-135 mph	'Considerable' damage: roofs torn off well constructed homes, homes shifted off their foundation, mobile homes completely destroyed, large trees snapped or uprooted, cars can be tossed.		
EF-3	136-165 mph	'Severe' damage: entire stories of well constructed homes destroyed, significant damage done to large buildings, homes with weak foundations can be blown away, trees begin to lose their bark.		
EF-4	166-200 mph	'Extreme' damage: Well constructed homes are leveled, cars are thrown significant distances, top story exterior walls of masonry buildings would likely collapse.		
EF-5	> 200 mph	'Massive/incredible' damage: Well constructed homes are swept away, steel-reinforced concrete structures are critically damaged, high-rise buildings sustain severe structural damage, trees are usually completely debarked, stripped of branches and snapped.		

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Report What You See
Scan The Sky & Ground for Clues…

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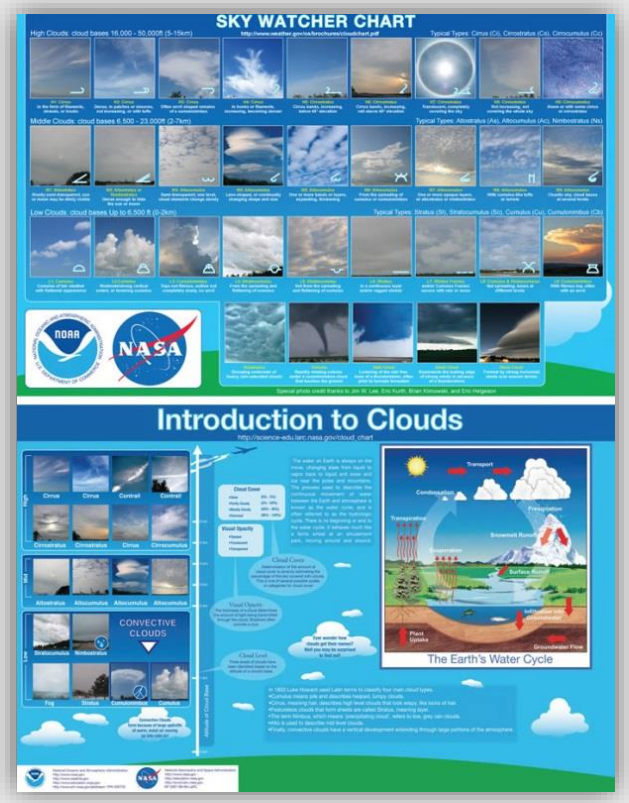
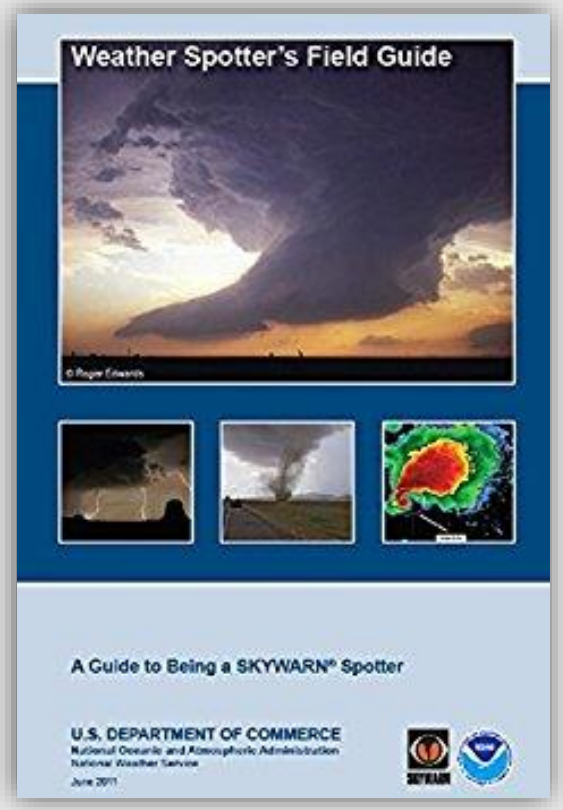
What do You See?

Additional Materials

Visit our SKYWARN spotter page for useful links and information: weather.gov/bmx/skywarnschedule

- This entire presentation in PDF format
- Need a refresher? Spotter schedule posted
- Supplemental training materials

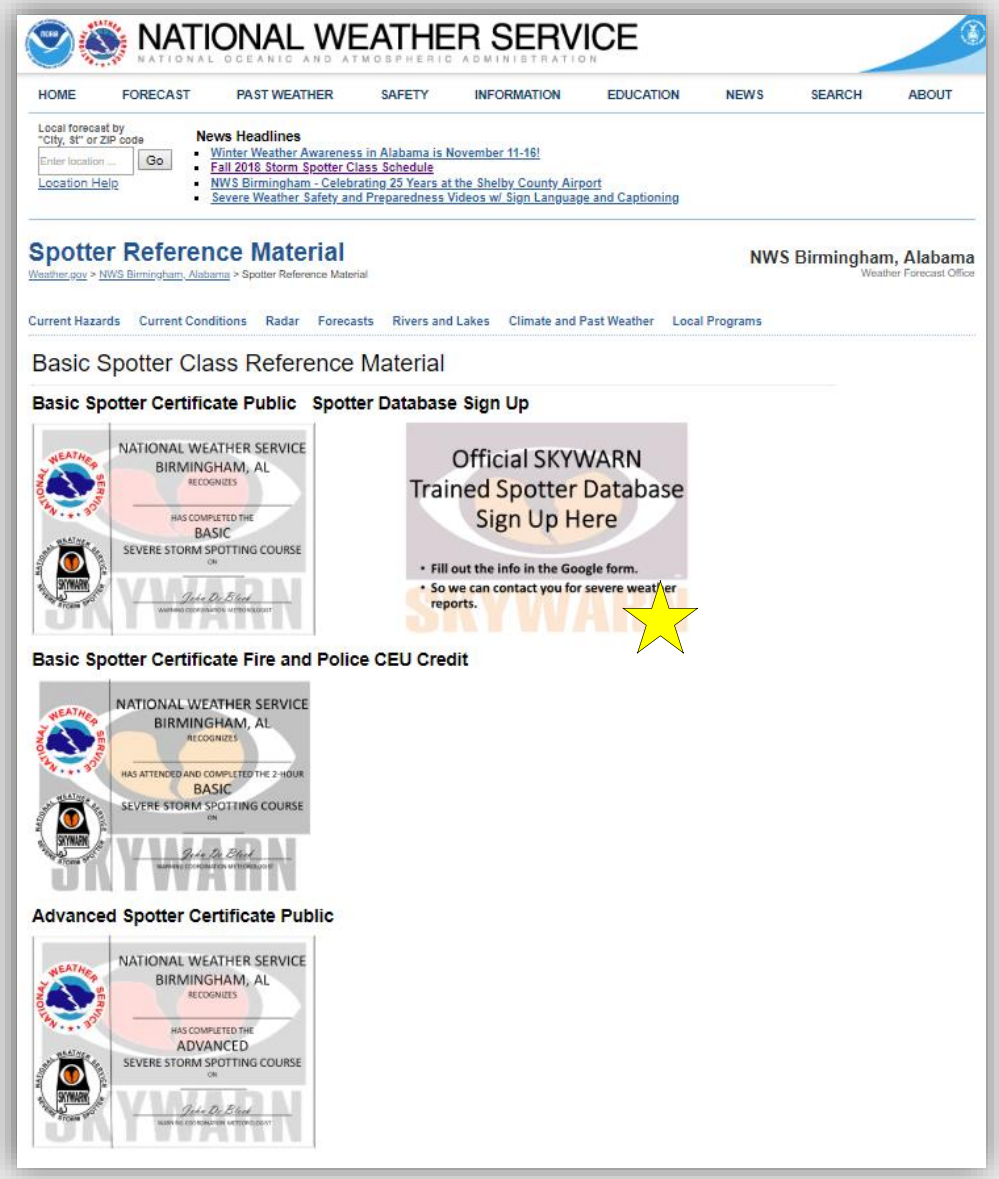




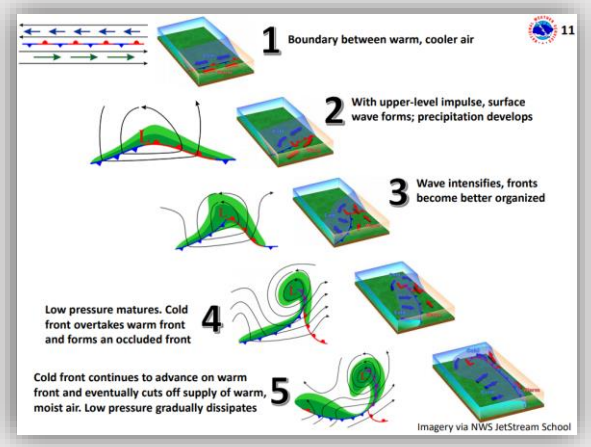
Spotter Certificate

weather.gov/bmx/spottertraining

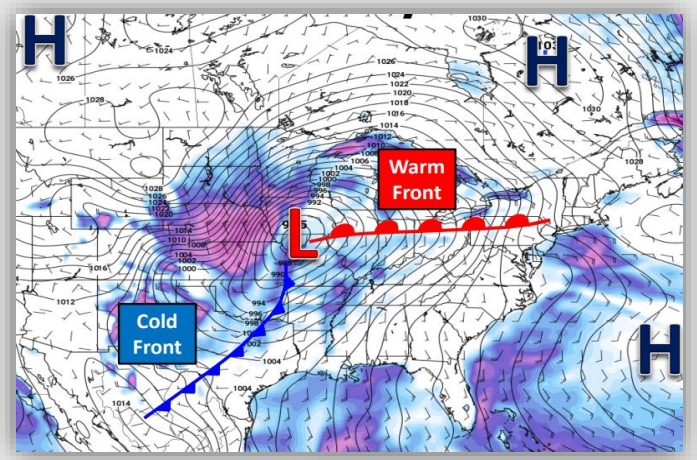
- PDF spotter certificate (print and self sign)
- Spotter database sign-up (auto filled and e-mailed certificate). Only if you live in Central Alabama/NWS Birmingham service area.

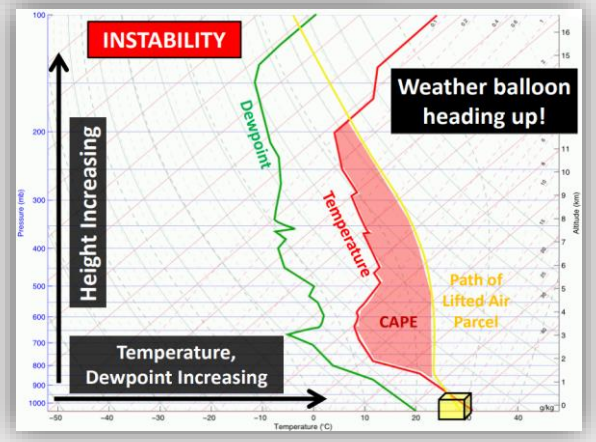


Advanced Spotter Course
Thursday, Nov 12 at 6:30 PM



- Structure of weather systems
  -Low and high pressure, fronts
  -Troughs and ridges
- Learn about severe weather forecasting
  -Parameters
  -Satellite and radar analysis
  -Soundings
- Go over a real-life severe event, or two





Thanks for Attending!

Questions or Curiosities?

NATIONAL WEATHER SERVICE

BASIC STORM SPOTTER TRAINING

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